LAKE & WATERSHED ASSOCIATES
PO Box 65 Turner ME 04282
207-576-7839 · LWRMA@megalink.net

2022 Hogan and Whitney Ponds Water Quality Monitoring and Assessment Report

Executive Summary

Indicators of water quality for Hogan and Whitney Ponds were assessed on August 12, 2022, and were compared to historical averages for the two lakes. Monitoring and sampling took place at the "deep hole" (Station 01) for both lakes – in accordance with standard lake monitoring practices established by the Maine DEP and Lake Stewards of Maine. Additional data for Whitney Pond included in this report were provided by certified volunteer lake monitor, Bruce Wilson. The value of volunteer data in the assessment of Maine's lakes cannot be overstated.

Although Hogan and Whitney Ponds are separated by a narrow gravel esker, the water characteristics of the two lakes are distinctly different – largely due to the fact that the drainage areas (watersheds) for the two have different morphometric and hydrogeological features. Shoreline and upland development also varies for the two bodies of water.

Hogan Pond was somewhat clearer than its historical average, while Whitney was virtually the same as the average*. The concentrations of total phosphorus, the key nutrient that influences algal growth in lakes, and chlorophyll-a, which directly measures algal density, were lower (better) than the historical averages for both Hogan and Whitney Ponds.

Late summer dissolved oxygen concentrations in the deepest areas of both lakes were very low (depleted) in both Hogan and Whitney Ponds, but oxygen loss was more severe in Hogan, because the lake is deeper, and thermal stratification is stronger. It is likely that this phenomenon will become more pronounced in both lakes as the climate warms in the future. Phosphorus samples taken close to the bottom at the monitoring stations of both lakes were high enough to suggest that there may have been some release of the nutrient from the bottom sediments, triggered by the low oxygen.

Shorter periods of ice cover (from late fall formation to early spring), record high summer water temperatures, a longer growing season for algae and other lake plants, and an increase in severe weather, ranging from soil-eroding storm events to extended periods of drought will not benefit the future health of Hogan and Whitney Ponds, and lakes throughout Maine. Ongoing efforts to protect the lakes through aggressive watershed conservation initiatives will continue to be essential to their long-term health.

**Note that the historical indicator averages have not been updated by the Maine DEP since 2018. The update process through 2022 is currently taking place..*

Lake Water Quality in the Era of a Warming Climate:

Lake water quality may be influenced at any point in time by a wide range of both natural and anthropogenic factors. The combined effect of these has a bearing on the extent to which monthly, seasonal and annual "natural variability" occurs in many of the indicators that are used to assess lake ecosystems.

Annual weather fluctuations and trends in temperature, wind, and precipitation typically influence both short and long-term conditions that occur in individual lakes. The degree to which they affect individual lakes depends on the natural characteristics of the lake, and the extent to which the lake and watershed have been altered through development. Natural characteristics include, but are not limited to the bathymetry (depth profile) and shape of the lake basin and its orientation to prevailing winds, and the land area, soil geochemistry, and hydrologic characteristics of the watershed. Natural features such as wetlands within the watershed may also be factors. The combined effect of these variables plays a role in the sensitivity and response of individual lakes to watershed development.

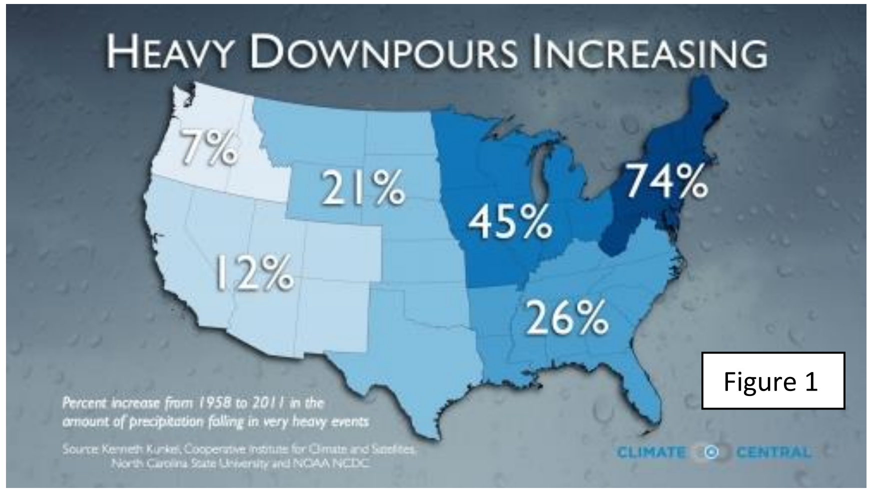


Figure 1

Foremost among the influences of weather on our lakes are precipitation and temperature, both of which are increasing in intensity through the process of climate warming (see Figure 1; Source NOAA)). In recent years, unusually warm ambient temperatures throughout the year have resulted in historic high summer lake water surface temperatures (mid 80's F in southern and central Maine), later formation of ice cover in the fall/winter, and earlier "ice out" in the spring. The overall reduced period of ice cover on lakes is a clear indicator of the potential changes that climate warming will likely have, and almost certainly is now having, on Maine's lakes, relative to their historical state.

Precipitation events are becoming more extreme, and multiple years of moderate to severe drought have occurred throughout much of Maine during the past two decades. Intense rain events can significantly increase the erosive force of watershed stormwater runoff, transporting more sediment and phosphorus into lakes. Drought reduces the inflow of water to lake basins from their watersheds and increases evaporation of lake water, resulting in low water levels, which can cause the desiccation of sensitive, beneficial aquatic plant communities, reduce/impair fishery habitat, and it may contribute to shoreline erosion. Drought is typically associated with warmer ambient temperatures and an increase in lake water temperature.

Drought is often punctuated by localized extreme precipitation events, during which high-velocity, erosive stormwater runoff from the watershed reaches lakes, carrying with it elevated concentrations of soil particles, nutrients and other pollutants. In recent years, unusual algal blooms that have been observed and documented in a number of Maine lakes are likely to have been triggered by the combined effects of extreme weather.

Historically, it has generally been accepted that clearer lake water is an indication of healthy lake ecosystems. This may not always be the case in the era of climate change. Many Maine lakes tend to be clearer during drier years, ostensibly due to reduced stormwater runoff from their watersheds during such periods, resulting in less algal growth. Algae are essential to the overall health and biological diversity of lake ecosystems. A significant decline in algae, combined with warming lake temperatures, may result in the disruption of lake food webs, and along with rising water temperature, may contribute to stress to fisheries from the loss of critical habitat to greater susceptibility to parasitic infections.

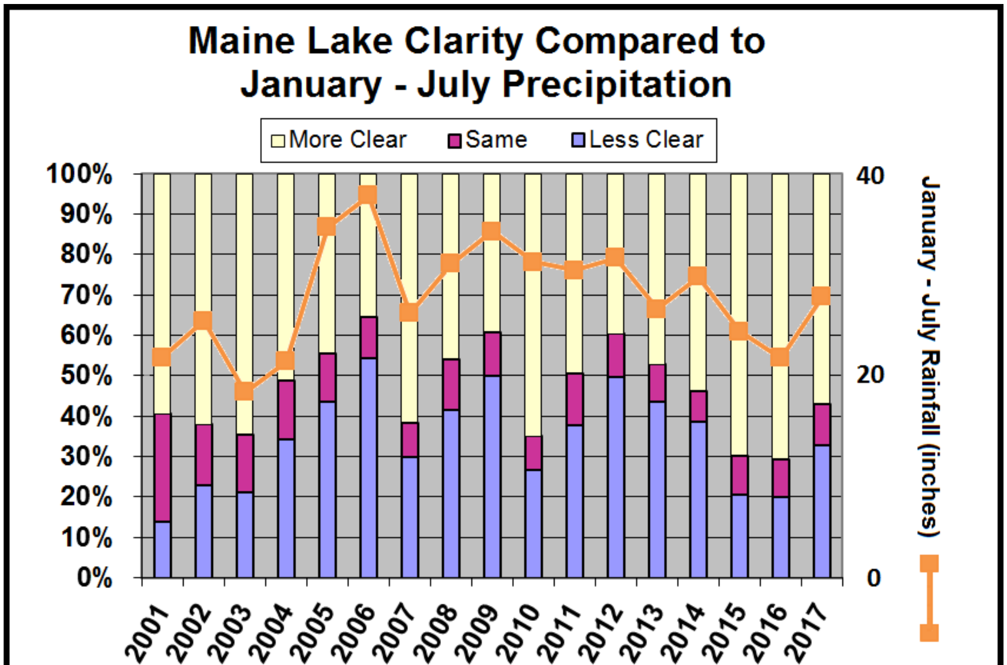


Figure 2 Source: Bacon, MDEP; Williams, LSM

An observational analysis of the Secchi transparency (water clarity) of Maine lakes from 2001 through 2017 (Linda Bacon/MEP; and Scott Williams/LSM) showed that during that period of time, a significant number of Maine lakes tended to be clearer during drier years (see Figure 2). Stormwater runoff is the vehicle by which phosphorus and other pollutants are transported from watersheds to lakes. Lakes tended to be less clear during years when there was greater precipitation and runoff during the period from January through mid- summer. Periods of drought may be deceptively causing apparent improving trends (based on water clarity) in water quality for some lakes in Maine, based on deeper Secchi disk readings, and lower concentrations of phosphorus and planktonic algae. This observational study suggests that stormwater runoff from lake watersheds contributes to reduced lake clarity, but it also raises questions about whether an increase in lake clarity should always be considered beneficial to lakes. In the future, it will be increasingly important to take into account the influence of extreme weather associated with a warming climate when assessing lake water quality.

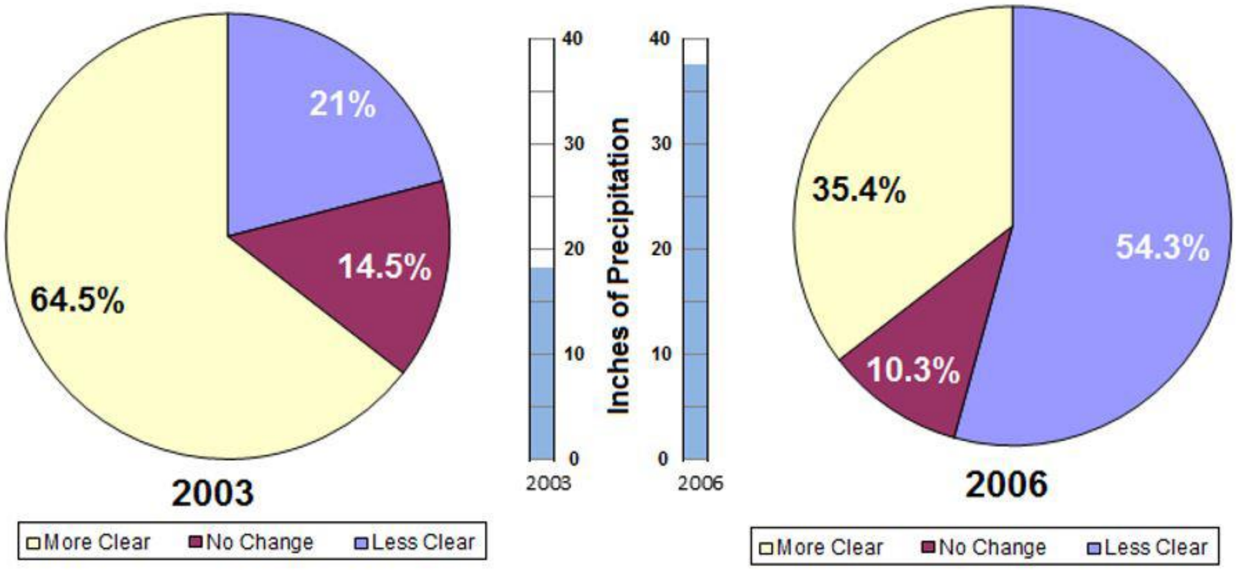


Figure 3: Source: Bacon/MDEP; Williams/VLMP

The pie charts in Figure 3 (above) illustrate the dramatic change that occurred in several hundred Maine lakes that were clearer than, less clear, or unchanged from their historical averages in 2003 and 2006. The bar graph between illustrates the differences in precipitation for the period from January through July for each of the years.

While a majority of Maine's lakes have been clearer to varying degrees during drier years, smaller groups of lakes have either been unchanged, or in some cases, have been less clear than their historical average. This may be due to several factors, including current water quality conditions in individual lakes, the degree to which a lake watershed is developed, whether or not the lake is experiencing internal phosphorus loading and recycling (in additional to external/watershed sources) - and more recently, the possibility that warming lake water temperatures are causing longer periods of thermal stratification. Relatively shallow lakes that have undergone little or no stratification in the past are now experiencing this phenomenon (see Figure 4) – which may, in some cases, exacerbate dissolved oxygen loss and the release of phosphorus from lake sediments to the overlying water, resulting in greater planktonic algae growth and reduced water clarity.

An extended period of thermal stratification typically results in greater loss of dissolved oxygen in the lake water column during the period because warmer water is able to contain less dissolved oxygen, and water in the deepest area of stratified lakes is isolated from atmospheric sources of oxygen for longer periods. Depending on the biological productivity of individual lakes, oxygen concentrations may drop to critically low levels, triggering the release of phosphorus in the lake sediments to the overlying water. The "pulse" of phosphorus associated with this internal release process may, under certain circumstances, result in a substantial increase in planktonic algal growth, and reduced water clarity, especially during the late summer and early fall period.

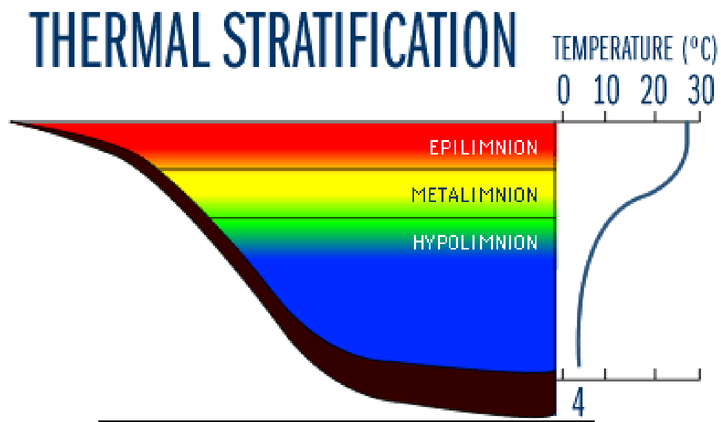


Figure 4: Typical Summer Temperature Profile in a Thermally Stratified Lake

Another small group of lakes that may actually be clearer during wet years are those that are highly productive, and which experience persistent severe algae blooms. These lakes may actually benefit from the diluting effects of precipitation, because phosphorus concentrations in the body of water are higher than incoming levels in stormwater runoff.

Climate warming, and associated extreme weather events may compound (and confound) the complexity of tracking, predicting and characterizing lake water quality. In recent years, an increasing number of lakes that have historically experienced relatively "good" water quality, and which have otherwise been considered to be stable, have experienced significant changes, very likely due to the de-stabilizing influence of a warming climate. Although in some cases it may be possible to predict the manner in which individual lakes will respond to climate change, the process through which warming effects complex biogeochemical reactions in lake ecosystems may not always be clear in advance of the changes.

Potential Weather Influences in 2022

Maine once again experienced a relatively dry summer in 2022. While the extent of the drought varied, most of the state experienced below average precipitation for the first several months of the year. For the past few years, Maine has experienced drought ranging from "abnormally dry conditions" to "moderate and severe drought" (source: Drought.gov).

The effects of drought on lakes may be cumulative, depending on the amount of time that it takes (on average) for the volume of water in a lake to be replaced, or "flushed" (not to be confused with "turning over", or mixing). Because this natural process is relatively slow, a dry year may continue to influence water quality and ecological effects for a year or more following the period of drought. Drought-related effects may be cumulative, depending on the duration and severity of drought conditions.

Drought conditions in Maine changed dramatically during the last months of 2022, which has been characterized as one of the wettest periods in more than a century. The abrupt reversal, resulting from multiple heavy precipitation events, may result in many lakes being less clear than their historical average in 2023 – depending, in part on conditions during the spring runoff period, following snowmelt.

The graphic below (Figure 5: Source: Drought.gov) illustrates the significant drought conditions in Maine from 2000-present (January, 2023). The color box in the lower left begins with “abnormally dry” in yellow, to more extreme conditions in the far right boxes. Note that many years since the severe drought period of 2001-2003, show significant drought conditions.

2000 - Present (Weekly)

The U.S. Drought Monitor (USDM) is a national map released every Thursday, showing parts of the U.S. that are in drought. The USDM relies on drought experts to synthesize the best available data and work with local observers to interpret the information. The USDM also incorporates ground truthing and information about how drought is affecting people, via a network of more than 450 observers across the country, including state climatologists, National Weather Service staff, Extension agents, and hydrologists. Learn more.

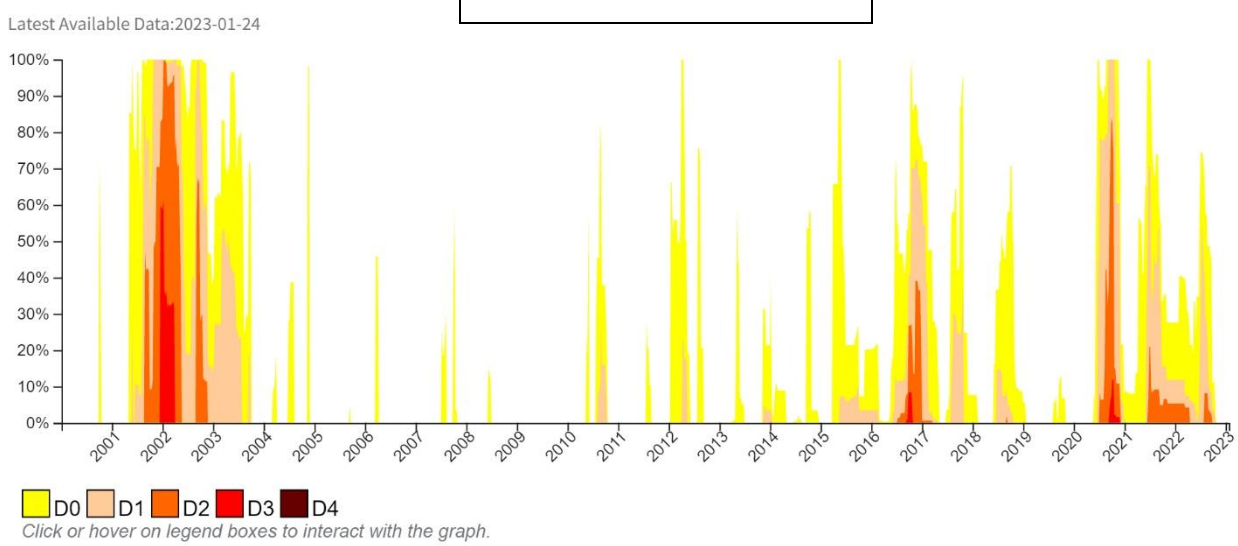


Figure 5: Drought Conditions in Maine from 2001 through early 2023

Overview of Lake Water Quality Monitoring Process

The following summary information is the product of “baseline” sampling and assessment that was conducted at Hogan (MIDAS 3770) and Whitney (MIDAS 3772) Ponds, situated in Oxford, Maine on August 12, 2022 by LWRMA staff. Additional data were contributed by Certified Volunteer Lake Monitor, Bruce Wilson.

Water quality monitoring/sampling was conducted at the “deep hole” station, which is the deepest known location in the lake, and it is the area where the greatest volume of historical data has been gathered for several decades. The deep hole monitoring station (#01) is generally representative of overall conditions in single basin lakes. While some variability may occur within the lake basin, this is typically due to the influences of tributaries and “near shore effects” from wind and wave action.

The intended purpose of comprehensive baseline monitoring is to assess the overall water quality status of a lake system – primarily from a perspective of lake “productivity”. The most significant threat to the health of most Maine lakes is the potential for a significant increase in biological productivity, resulting from watershed development. An increase in productivity in lake ecosystems is typically characterized by an increase in the nutrient phosphorus, resulting in a reduction in water clarity from accelerated algal growth, the loss of dissolved oxygen during periods of thermal stratification, reduced biodiversity in the lake phytoplankton (algae) community, and increasingly with climate warming, a shift in dominance toward cyanobacteria (aka bluegreen algae).

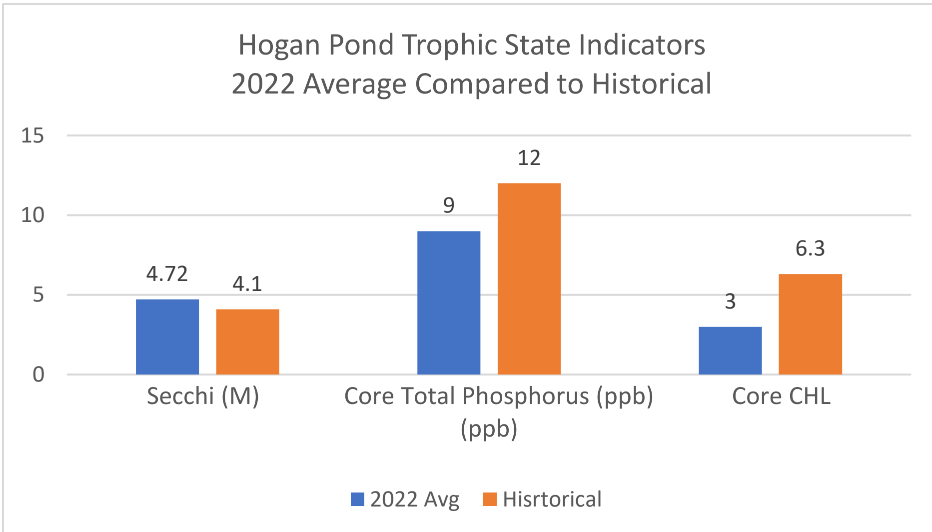
For most Maine lakes, August and early September sampling is generally considered to be the most critical “window” of the year because potentially stressful conditions in the lake associated with several months of warm weather are typically most evident. Ideally, in order to confidently detect both short-term changes (such as an impending algal bloom), as well as long-term trends, a minimum of monthly sampling frequency is required for at least five continuous months during the open water period from May through September or October. Historical data sources referenced are from the Maine Department of Environmental Protection, Lake Stewards of Maine (www.lakesofmaine.org), and LWRMA field records and reports.

The characterization of changes that take place in a lake from one year to the next can easily lead to misunderstandings about the conditions in a lake. While terms such as “above and below average” may be relevant for one or more critical indicators of water quality, the same term may not fully take into account the fact that lakes are highly dynamic systems that are in a constant state of flux, often with significant continuous change occurring throughout any given year.

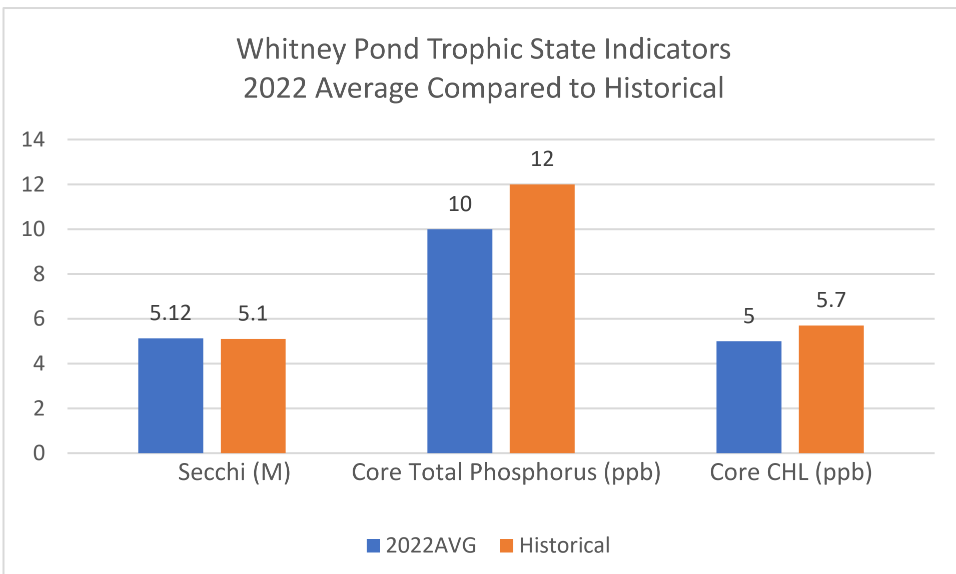
Hogan and Whitney Ponds Water Quality Monitoring Results for 2022

In 2022, the three primary “trophic state: water quality indicators (Secchi transparency, total phosphorus and chlorophyll-a) varied somewhat from the historical averages for both Hogan and Whitney Ponds (Figures 6&7). The water clarity (Secchi transparency) in Whitney Pond was essentially the same as the historical average while Hogan was clearer than its average over time. However, it should be noted that the Hogan Pond average is based on a single reading in 2022, whereas Whitney is based on multiple readings taken over a period of several months. The concentration of epilimnetic core total phosphorus, the key nutrient that has a bearing on algae growth, was somewhat lower (better) than the historical average for both lakes, as was chlorophyll-a, which is a direct measure of planktonic algal density.

Note that the historical water quality indicator averages for Maine lakes have not been updated by the Maine DEP since 2018, but are currently in the process of being revised.



Figures 6 (Hogan) and 7 (Whitney)



Secchi Disk Transparency**:** Figure 8 illustrates the variability in Secchi transparency (water clarity) readings at monitoring station 01 on Whitney Pond. Hogan Pond was limited to a single reading in August, and is not represented in graphic form.

The highest (clearest) reading of 5.64 meters were recorded on August 12, and the lowest (least clear) reading of 4.95 meters was taken on August 20. The average for the 6 month span (7 readings) was 5.1 M, which is also the historical average for the lake. On August 12, Whitney Pond was experiencing a significant planktonic algal bloom, characterized by macroscopic clusters of bright green algae throughout the upper region of the water column. The phosphorus and chlorophyll samples taken on August 12 do not reflect conditions that were observed in the lake, most likely because the integrated core samples (3) taken did not capture any of the clusters, any one of which could have significantly increased the concentration of both indicators.

The dominant algae appeared to be *Planktothrix*, a filamentous cyanobacterium (bluegreen algae) that has been observed in Whitney Pond during the late summer for more than a decade. The density and intensity of the 2022 bloom appeared to be greater than has been noted in past years. Bruce Wilson noted that the bloom persisted through the date of his August 20 Secchi reading (4.95 Meters). It is likely that the algal clusters had started to senesce (deteriorate) at that time, which would account for the significant decline since the August 12 reading of 5.64 meters.

On August 12, the Whitney Pond water level appeared to be significantly lower than the normal high water mark for the lake. The water level in the channel connecting Whitney and Hogan Ponds was very low at that time, likely due to persistent drought conditions throughout the spring and summer.

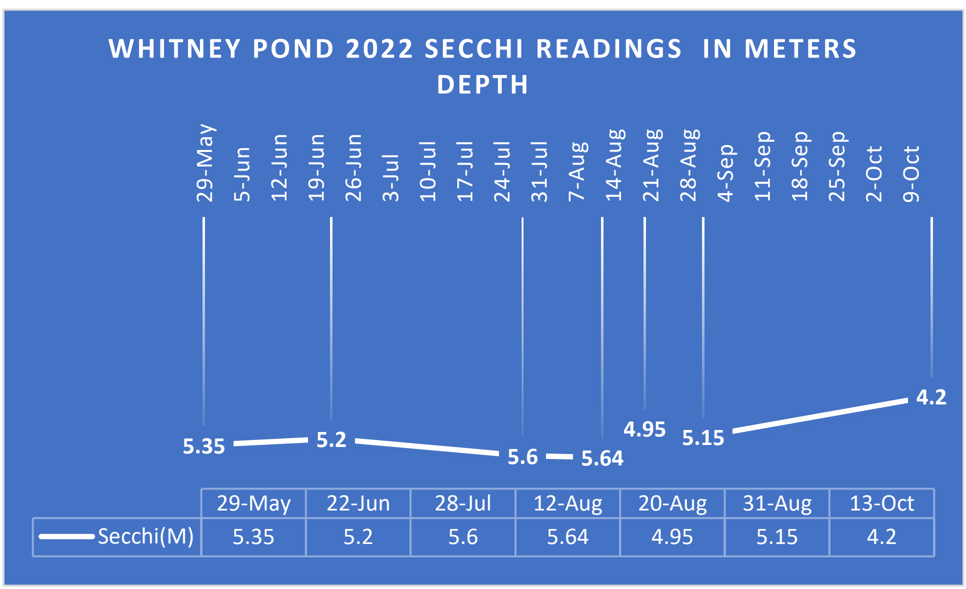


Figure 8

The Hogan Pond Secchi reading of 4.72 meters on August 12 was substantially higher than the 4.1 meter historical average. It should be noted that the average for this lake includes a number of years during which time a full season of readings were taken, along with single readings for most recent years. The relatively clear reading for Hogan Pond in 2022 was likely influenced in part by drought conditions.

<u>Total Phosphorus:</u> Integrated core total phosphorus samples taken on August 12 were similar for the two lakes (9ppb for Hogan and 10ppb on Whitney). Both were significantly lower than their historical averages of 12 ppb.

Total phosphorus samples taken near the bottom of the deepest points at both monitoring stations in August, when dissolved oxygen was depleted in the lowermost 7 meters at Station 01 on Hogan and 1 meter at Station 01 on Whitney, measured 16b ppb on both lakes. The significantly elevated concentration of both samples (compared to the core samples) may have been an indication that phosphorus was being released from the bottom sediments as a result of anoxia in the overlying water.

The relatively shallow bathymetry of Whitney Pond is such that the thermal stratification that forms during the summer period is weak and "ephemeral". It is likely that the lake experiences partial or complete mixing during periods of moderate wind. Previous late summer temperature profiles have suggested that during periods of relatively calm wind, stratification is stronger, and oxygen depletion is greater than what was documented in 2022. Lakes with bathymetry similar to Whitney may be more susceptible to internal phosphorus recycling than deeper lakes that do not mix as often during the open water period of the year. This phenomenon may be linked to the persistent late summer algal blooms that have been documented on this lake.

<u>Chlorophyll-a, (CHL)</u>**:** Chlorophyll-a is a direct measurement of the concentration of planktonic algae in the lake. On August 12, a core CHL sample measured 3 ppb on Hogan Pond, and 5 ppb on Whitney, compared to the historical averages of 6.3 ppb and 5.7 ppb respectively.

Additional Water Quality Indicators Monitored in 2022

<u>Water color:</u> Lake water color is a natural phenomenon that is primarily influenced by humic compounds contained in watershed wetland vegetation and deciduous leaves. Color measured 18 Standard Platinum/Cobalt Units (SPU) in Hogan Pond and 14 ppb in Whitney, compared to their historical averages of 29 and 13 respectively. The color level in Hogan was unusually low for the lake, possibly the result of reduced watershed inputs during the drought period. Moderate to high concentrations of natural color in some lakes can influence water clarity, total phosphorus and chlorophyll levels. This influence is not considered significant when the color concentration is below 25 SPU.

<u>Water Temperature:</u> Unusually high summer lake water temperatures have been documented in lakes throughout Maine during the past few years. On August 12, the water surface temperature at station 01 on Hogan Pond measured 26.5 degrees Celsius (79.9 F), and 26.4 C. on Whitney (79.5 F) – very warm surface temperatures for a Maine lake during the late summer. On that date, both lakes were thermally stratified, with temperatures ranging from 26.5 C at the surface at Hogan to 9.7 C at 10 meters depth, just above the lake bottom at 10.8 meters. Whitney Pond temperatures ranged from 26.4C at the surface to 20.4C at 6 meters depth, about 1 meter above

the lake bottom. The temperature gradient on Whitney was relatively stable until about 5 meters depth, dropping sharply at 6 meters (see Figures 6&7).

Dissolved Oxygen (DO): The concentration of DO was virtually depleted at station 01on August 12 in the lowermost 7 meters depth on Hogan Pond. DO was stable from the surface to 5 meters depth on Whitney, and it was depleted at 6 meters, just above the bottom of the deepest area of the lake. DO concentrations were similar to recent years, although slightly more severe on Hogan. DO loss in Whitney Pond seldom becomes severe (but is still significant) because the lake mixes periodically during strong winds, at which time, DO is partially or fully replenished for a period. Depending on weather circumstances, Whitney may re-stratify following such weather events, and additional DO loss may result at such times. The temperature and dissolved oxygen profiles for both lakes on August 12 are illustrated in Figures 9 & 10.

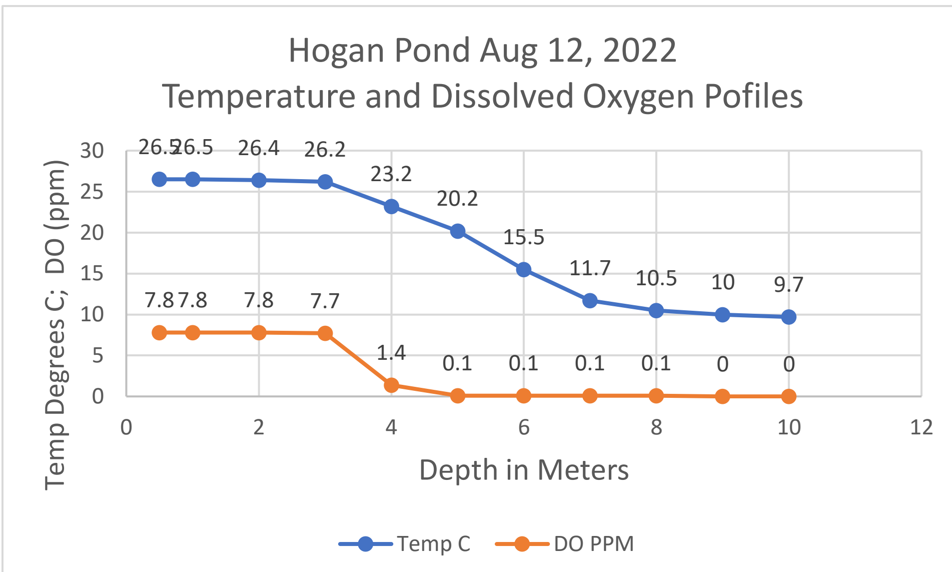


Figure 9

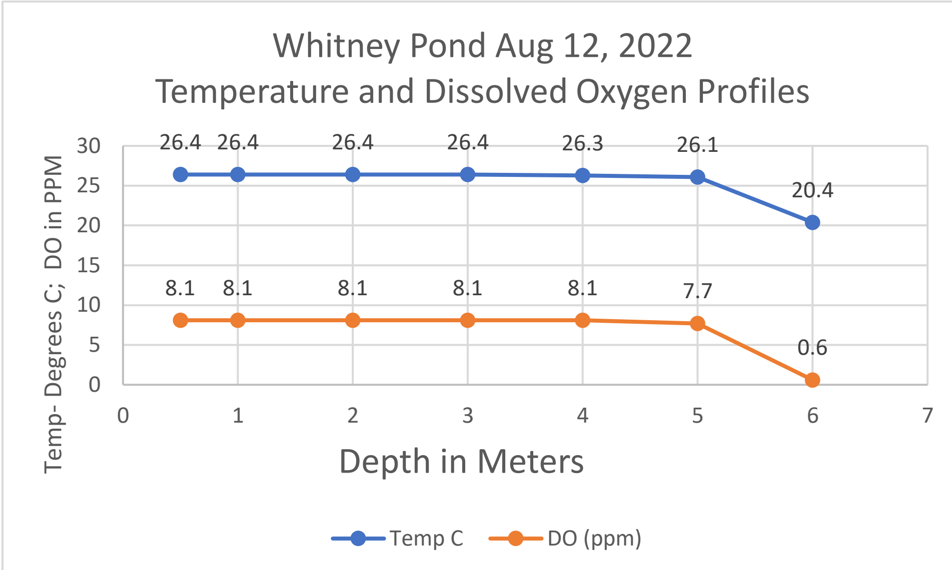


Figure 10

Low DO in lakes during the summer months has multiple implications: It may be considered to be the "canary in the coal mine", in that DO loss over time can be an indicator of stress to the lake system from an increase in nutrients from both external (watershed) and internal (lake sediments) sources, which can result in an overabundance of algal growth. This can serve as a potential warning signal that a lake is nearing its natural balanced assimilative capacity. Once this "tipping point" is exceeded, lake water quality can decline rapidly. Late summer DO loss is likely to be exacerbated as summer water temperatures increase due to climate warming.

Low DO also limits coldwater fishery habitat, and it may trigger a process, in which soluble phosphorus is released from the bottom sediments into the overlying water. The extent to which this latter phenomenon occurs, and the mixing dynamics of the lake determine whether or not the soluble P is able to be metabolized by planktonic algae closer to the surface. This process is influenced by the geochemistry of the lake sediments – primarily involving the ratio of naturally occurring aluminum to iron in the sediment, and the concentration of phosphorus in the lake.

Lake water temperatures that are substantially higher than in past years represent a significant risk factor for an increase of potentially harmful (toxic) algal blooms in Maine's lakes. Unusually warm lake water also stresses the biota, and has been linked to fish mortality in a number of Maine lakes in recent years. Climate warming has the potential to significantly worsen this phenomenon because warmer weather will likely strengthen and lengthen periods of thermal stratification and DO loss, and warmer water may favor the growth of cyanobacteria over other forms of algae. Figure 11 illustrates a possible scenario, in which a shift in the abundance of bluegreen algae in lakes could occur as a result of warming water temperatures (Source: MDEP)

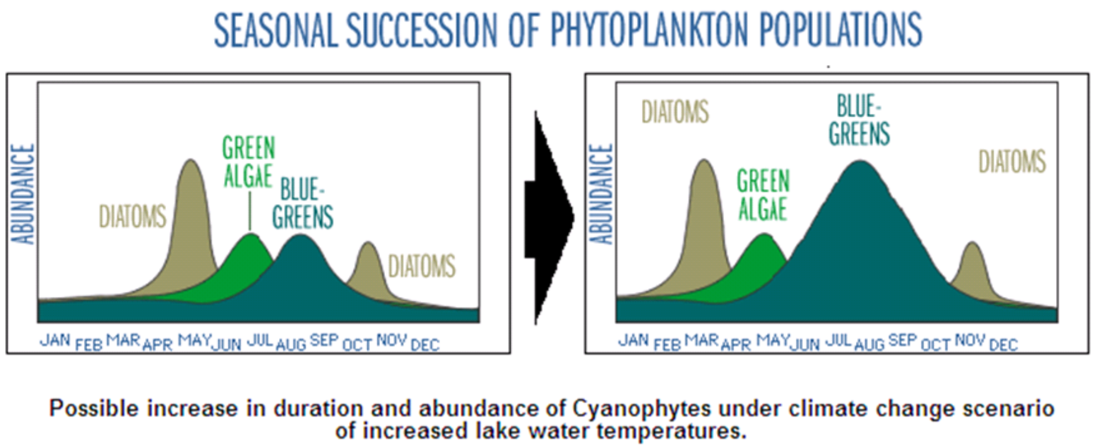


Figure 11

Total Alkalinity is a measure of the capacity of lake water to buffer acidified precipitation and water entering the lake from its watershed. On August 12, Alkalinity, measured 14 milligrams per liter (Mg/L) in Hogan Pond, compared to the historical average of 14 mg/l and 11.5 mg/l in Whitney, compared to the historical average of 11 mg/l for the lake. Some annual variability of total alkalinity is common, and likely influenced by weather factors that affect watershed hydrologic inputs (or lack thereof during periods of drought) from tributaries and runoff.

"Metaphyton" is a broad term that refers to a number of species of filamentous algae that form cotton candy-like green/yellow "clouds"(Figure 12) in shallow areas of lakes, and streams. Metaphyton occurs naturally, and provides a number of ecological benefits to lake ecosystems. The algae that constitute metaphyton are common in lakes throughout Maine. They provide food and beneficial habitat for a wide range of fauna in lakes. However, many lake communities, volunteer lake monitors, and lake scientists have reported a substantial increase metaphyton abundance in recent years (observational data). The significance of this increase is not fully understood, but may be the result of some influence(s) of weather events associated with climate warming. Continued monitoring and reporting unusual changes in the abundance and location of this algae will hopefully lead to a better understanding of its ecological significance.

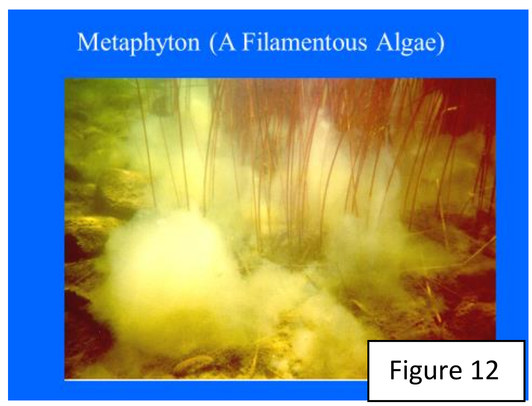


Figure 12

Metaphyton abundance is difficult to quantify in individual lakes because this alga is typically not uniformly distributed throughout the body of water. In recent years, we have observed varying degrees of metaphyton growth in both Hogan and Whitney Ponds, and in the outflow channel that connects the two. Conditions observed on August 12 were somewhat typical for both lakes, although an extended survey of the shoreline of each lake would be required to accurately characterize any significant changes.

Gloeotrichia echinulata is a bluegreen algae (cyanobacteria) that has been observed/documented historically in a number of relatively clear Maine lakes. However, historical concentrations of this species, which forms colonies that are visible to the naked eye, have been very low. In recent years, "Gloeo" has been documented in an increasing number of less clear lakes, and at higher densities. The significance of this increase is not fully understood, but some information suggests that it may be influenced by factors associated with climate warming and historical watershed land use. Gloeo was documented in moderate to high densities in the severe algal bloom that occurred in Lake Auburn in 2012. No Gloeo colonies were observed on August 12 at the monitoring stations of either Hogan or Whitney Pond, and none were observed along the downwind shorelines of either lake. Figure 13 is a magnified image of a Gloeo colony

Figure 13

Additional Water Quality Visualization Graphics

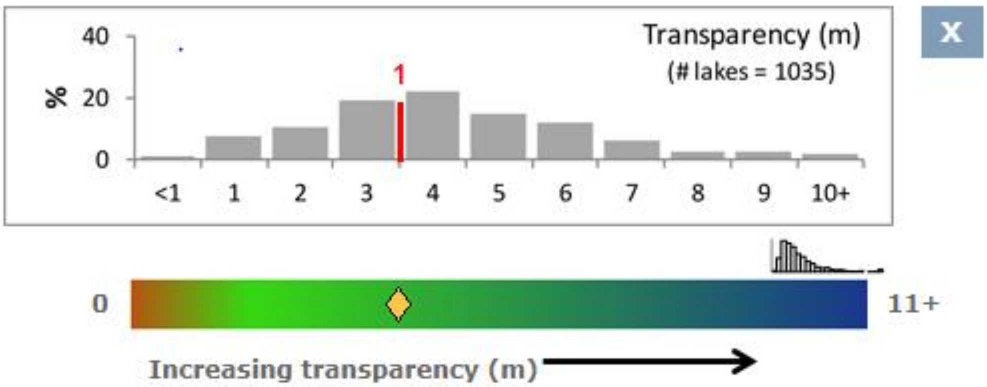
The following graphics may be helpful in putting the 2022 findings for Hogan and Whitney Pond in perspective. They allow readers to visualize the historical average for the three key trophic indicators (Secchi Transparency, Total Phosphorus and Chlorophyll-a), within the potential range for each indicator, as well as where Hogan and Whitney Ponds are situated, relative to a large historical data set for several hundred Maine lakes.

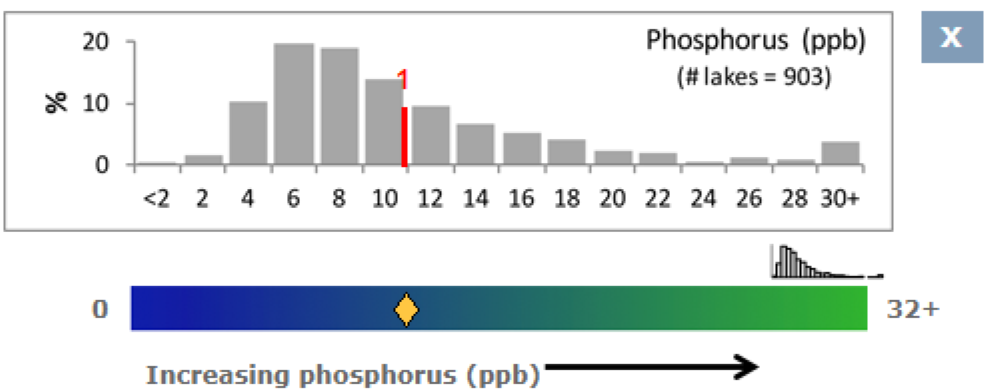
The "color ramps" below, produced for, and copied from the www.lakesofmaine.org website, illustrate the range of data for three critical indicators of water quality for Hogan and Whitney Ponds. The yellow diamond on each ramp indicates the historical average value for each lake. The bar chart above each color ramp is a histogram that illustrates the distribution frequency for Maine lakes for each indicator. The histogram shows where the individual lake is situated, relative to the total number of Maine lakes assessed/represented (indicated by # of lakes). The red line represents the location of the individual lake in question, relative to other lakes in the range of values.

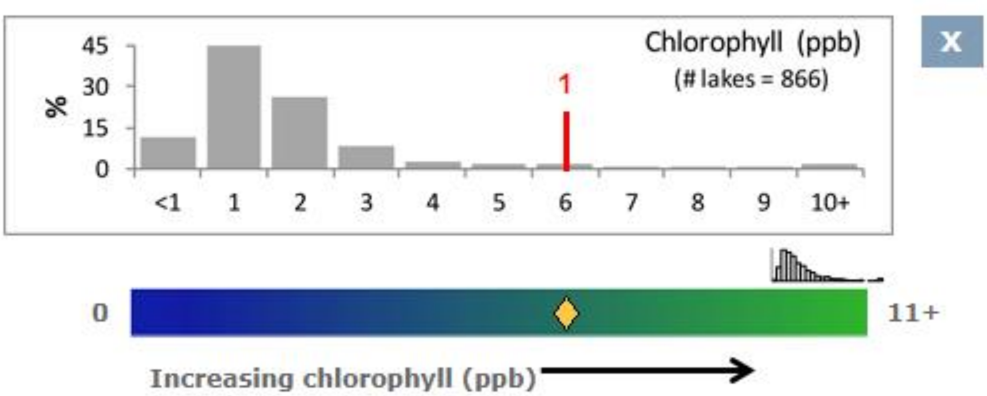
The first ramp shows water clarity, ranging from least clear on the left, to clearest on the right. The yellow diamond depicts the historical average, relative to more than 1,000 Maine lakes.

The second and third ramps represent total phosphorus and chlorophyll-a. Note that the color ramp scales for total phosphorus and chlorophyll below illustrate higher (better) water clarity on the left side of the ramp scale, whereas the Secchi transparency ramp above shows clearer water clarity/quality on the right end of the scale.

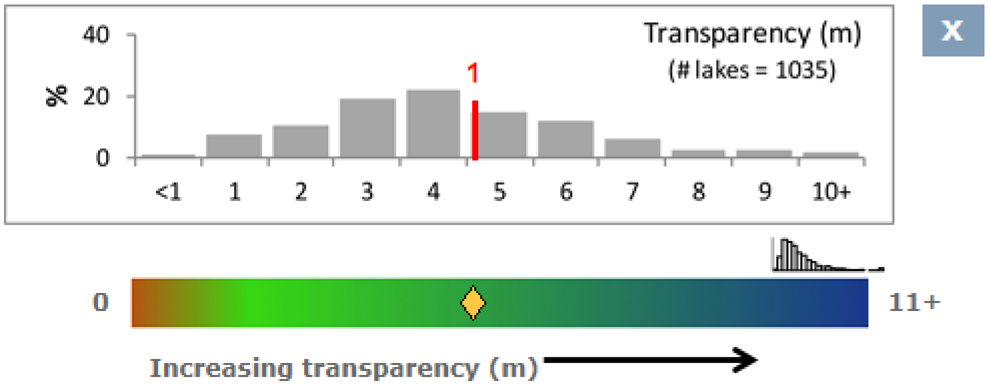
Hogan Pond

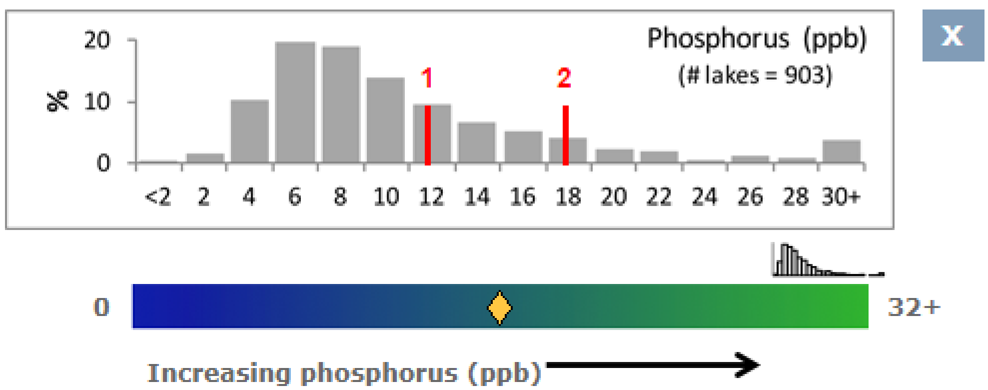


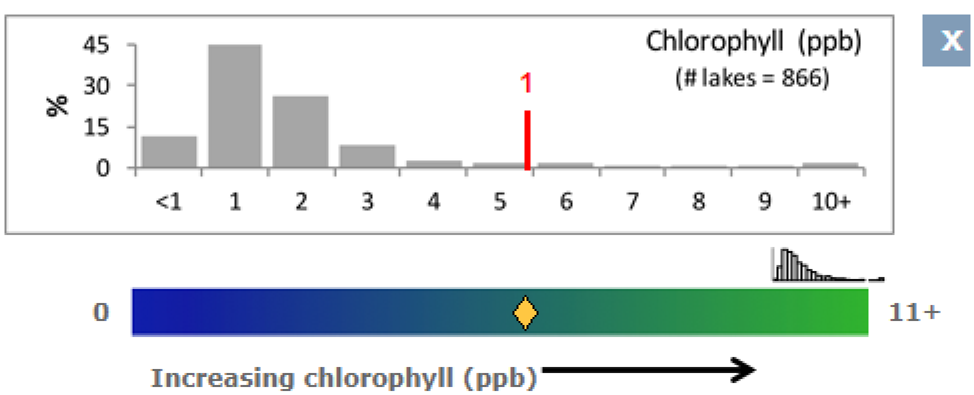




Whitney Pond







Summary and Recommendations

Indicators of lake water quality monitored in Hogan and Whitney Ponds in August, 2022 were similar to, but varied somewhat than the historical averages for the two lakes, as described in the Executive Summary and discussion of the specific findings section of the report. “Natural variability”, influenced by weather, normal cyclical transitions of aquatic flora and fauna, and other factors, accounts in varying degrees to the changing values of indicators of lake water quality throughout much of the year. Continued gathering of data from both lakes and their watersheds over time is essential to our ability to interpret this variability, and is especially helpful in distinguishing changes caused by natural phenomena, versus anthropogenic influences.

Climate warming is a very real threat to the stability and ecological health of Maine’s lakes. Mid- summer lake water temperatures above 80 degrees (F), combined with other weather extremes that have been documented in recent years, including intense, localized precipitation and runoff events, drought, reduced periods of ice cover, and other unusual meteorological phenomena pose a significant threat to relatively stable historical conditions in Hogan and Whitney Ponds.

During recent years, a number of lakes throughout Maine that have previously been considered to be stable, and which have had average to above average water quality, have experienced measurable negative changes, characterized by declining water clarity and a proliferation of cyanobacteria/bluegreen algae – often in the late summer and early fall. In some cases, the combination of the hydrologic sensitivity to phosphorus of the individual lake, watershed development pressures, and weather extremes, appear to have triggered the internal release of phosphorus from lake-bottom sediments, which can further accelerate a negative trend in water quality.

Once a lake exceeds its natural assimilative capacity, restoration may be difficult, uncertain, and very costly. In the era of a warming climate, preventing, documenting and resolving disturbances in the watersheds is especially important to protecting the health of the two lakes. Ensuring that new residential development, agriculture and timber harvesting incorporate “best water quality protection practices”, as well as revisiting and evaluating the effectiveness of existing water quality protective measures (properly sized culverts, runoff diversion practices and vegetated buffers) will be necessary, as the potential for the erosive intensity of stormwater runoff associated with extreme precipitation increases, potentially exacerbating threats to the health and resilience of Hogan and Whitney Ponds.

Prepared by Lake & Watershed Associates Senior Limnologist, Scott Williams