2023 Washington Lakes Water Quality Report

Report Prepared February 2024 with 2023 Data

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Special Thanks to Midcoast Conservancy and
Lake Stewards of Maine/Volunteer Lake Monitoring Program

Index to Washington Lakes Water Quality Report 2023

The Following Materials will help the reader understand the monitoring process, and for sake of brevity will not be included in this report but may be found in the 2019 or 2020 Water Quality Report

Executive Summary

Background

Prior to 2015, the WLWA (Washington Lakes Watershed Association), with the help of the Town engaged a paid analysis and report on lakes water quality but only on an every three years basis due to cost. Starting in 2015, under the auspices of VLMP/LSM*, WLWA volunteers undertook to create the report on an annual basis to give the town a more frequent and comprehensive view of lakes quality. This is the ninth report in that series. 2023 continues to add to the comprehensive data set with data created by WLWA, certified by LSM and accepted into the State of Maine database maintained by the Department of Environmental Protection (DEP).

Weather

Precipitation patterns have a profound effect on lakes. Heavy rains increase runoff and this adds phosphorus to the lake (naturally available in soils), promoting algae growth. Dry conditions remove this potential, resulting in clearer lakes. This year was WET. We had monthly rainfall, April through September, at or above previously recorded historical highs. Lake levels were high all summer, and in all we had six inches more rain during March-September than normal. Overall, average temperatures were only slightly above historical average; there were spikes of heat in April, May and September with a period of unusually cold in early June. In some areas test readings reflected these impacts.

Washington Pond (Midas 4894)

Washington Pond continues in reasonable shape for 2023. In 2020 it displayed the consistently highest secchi disk readings (clearest water) since the start of our database in 43 years ago. This year average readings declined due most likely to high rain and water levels.

Crystal Lake (Midas 4900)

In 1999 we reported abnormal readings on Crystal. 2020 was entirely normal, and our tests in 2021-2022 indicate it is remaining normal.. Secchi disk (water clarity, an indication of algae density) was slightly higher, but well within historical ranges. DO/Temperature readings in early summer showed some abnormal response to climate conditions but later readings leveled out well within normal range.

Invasive Species

There were no invasive **plant species** in either lake in 2023 to our knowledge. Although we do not think we have any invasive plants, we cannot be sure without looking at high probability sites. ***This is a major weakness in our "preventative" activities and we urgently need volunteers to take on this important task***. Training in this valuable work is available from Lake Stewards of Maine. Chinese Mystery Snails in the south end of the lake continues, but they are not known to have a negative effect on the water quality at the current infestation levels. They are an invasive nuisance and hopefully we can find a way to limit their nuisance factor. They are, however, a wake up call that Washington Pond and Crystal Lake can get invasives, and we should be patrolling for **invasive plant** and animal species as part of our lake monitoring activities. We need to get an active team to do so to help protect not only a pristine lake, but property and town economic values.

Volunteers for Citizen Science

Our call for volunteers was responded to in a most positive way. Jeff Grinnell and Scott Edwards became trained and certified monitors in 2022, while Anne Jenkins completed certification this year. Both were very active in taking readings on the water. Thanks Scott and Anne! We would like to add to the team in two ways: some younger people would be great, and if any resident on Crystal Lake would like to train with us, we can expand more frequent coverage of this water body.

Credits

The author is indebted to LSM/VLMP Staff (especially Tristan Taber) for support, training and education; Midcoast Conservancy (loan of instrumentation); Linda Bacon and the Maine DEP for historical database and record keeping; and the Washington Lakes Watershed Association (WLWA) for analytical laboratory costs and moral support.

I urge you to become more involved, volunteer time, and support the Washington Lakes Watershed Association with a contribution, for their work. With climate change, never has this been more important.

Roger Cady

February 2024

*LSM/VLMP Lake Stewards of Maine (formerly known as Maine Volunteer Lake Monitoring Program).

The reader is referred to Appendix I of the 2019 or 2020 Water Quality Report (available on the web at Washingtonlakesassociation.org) for more detailed explanation of each measured parameter and Appendix II of that report for comparison with other Maine lakes.

WATER QUALITY REPORT 2023

Sampling Methodology

During the 2023 summer season, under the auspices of Washington Lakes Watershed Association (WLWA) readings were taken of both Secchi Disk (water clarity) and Dissolved Oxygen readings every two weeks on Washington Pond. We resumed periodic monitoring of Crystal Lake. In addition, as has been customary, in late August or early September we take comprehensive (Baseline) water samples on both lakes which are analyzed by the State HETL (Health and Environmental Testing Lab) Laboratory. All data is submitted to the State DEP via LSM who certifies the data.

Midcoast Conservancy has been extremely helpful to loan us Dissolved Oxygen (DO) instrumentation for the entire summer. This has enabled bi-weekly DO data. We are indebted also for the loan of equipment and the aid in the Baseline sample collection for laboratory analysis.

All water quality monitoring and sampling was completed by a certified volunteer lake monitor and was completed in accordance with standard procedures for the monitoring of Maine lakes and ponds established by the Maine Department of Environmental Protection and the Lake Stewards of Maine and their Maine Volunteer Lake Monitoring Program. We owe a great debt of gratitude to LSM/VLMP for their support and training for certified monitors. This year's sampling was done in a manner consistent with the historical sampling of these bodies of water, and the results are comparable.

We hope that the beneficial relationship with Midcoast will continue in 2024. In particular, a close relationship with Midcoast might result in a more active invasive plant monitoring activity.

Tests Carried Out Biweekly

Water Clarity

Water clarity readings are made using a Secchi disk and monitoring scope to determine the depth at which the disk can still be seen. The higher the number (deeper sight depth), the clearer the water. This is a proxy measurement for chlorophyll density, this being a good indicator of plant and algae concentration. Readings were taken bi-weekly during the season and added to previous years data for Washington Pond dating back to 1977. Graphs compare Secchi disk depth readings for the summer period as well as showing annual data in the form of High, Low, and Average depth for each year, to give an historical reference for the bi-weekly readings.

Dissolved Oxygen and Temperature profiles

Lake water has an amount of oxygen dissolved in the water. This oxygen provides for respiration requirements of animal life, from the smallest forms up through fish in our lakes. Wind continues to cause mixing and the introduction of oxygen, as does photosynthesis by plant organisms, (a generator of oxygen) while respiring organisms and decomposition reduce the oxygen. Deeper water tends toward depletion in oxygen due to lower mixing and less light which reduces photosynthesis. This reduction affects fish, which must have at least 1-3 ug/l (1 ug/l is equivalent to 1 part per billion - ppb) of oxygen for adequate respiration. Various species of fish have varying temperature requirements, also. Cold water classified fish (such as trout) do not flourish if the water is warmer than 15 -16 degrees C, hence depleted oxygen below this tem-

perature stresses the fish, affecting their growth and reproduction. Even more important to lake ecology, depleted oxygen at the bottom of a lake facilitates an anoxic process that causes the phosphorus captured and held relatively harmless in the bottom sediments to be re-introduced into the water column. The level of phosphorus in our northern lakes is the single element that limits algae growth, so increasing phosphorus can promote unwanted algae blooms. Reducing anoxic conditions at the bottom helps keep the phosphorus in the sediments where it is relatively inert. More information on DO and lake turnover (spring and fall) is included in Appendix II of previous years' reports, available on the web.

Tests Carried Out Annually (typically late August)

Our comprehensive tests provide that we collect water samples for laboratory analysis at the State laboratory in two ways. The first is we collect water from a column of water from surface to below the temperature change (see Dissolved Oxygen curves). This sample of water from all depths is called the Epilimnetic Core (EC) sample. In addition, a sample of water is collected only from just above the bottom (bottom grab) to provide an analysis of the level of element phosphorus near the bottom .

Laboratory Analysis then reports on the following parameters from the core sample:

Phosphorus (partial determinant potential for algae growth). A phosphorus sample taken from the core water column (EC) sample is measured in per billion (ppb). As phosphorus is the nutrient that most directly influences the growth of algae in lakes and ponds and phosphorus concentrations in the 12-15 ppb range and above have been associated with algal blooms in some Maine lakes. Bottom samples (BG) help us understand the extent of the process of anoxic release of phosphorus from the bottom sediments. Low indicates less release is happening.

Chlorophyll-a (partial determinant for algae growth). Measurements of chlorophyll indicate amount of green pigment found in all plants and therefore is an indicator of amount of algae in the water. High CHLa levels mean that a lake is closer to sustaining an algae bloom. As in many of the measurements we take, the instantaneous value is less important than the longer term trend.

Conductivity (indicator of dissolved solids in the water and pollution level from runoff)

pH (indicator of alkaline or acid levels in the lake which will affect certain plant species)

Alkalinity (indicator of ability of lake to buffer changes in pH from plant or introduced causes)

Color (indicator of amount of humic acids and tannins leached into the lake, and it also affects water clarity)

2023 Weather Influences

Precipitation patterns have a profound effect on lakes. Heavy rains increase runoff and increasing Phosphorus introduced into the water from eroding soil where it naturally occurs, promoting algae growth. Dry years tend to be clearer (higher Secchi disk readings) however large rain events tend to bring in excess pollution from surrounding soils (a major source of phosphorous), encouraging more algae growth. **2023 was WET**. The rainfall amounts in April through September were consistently at the maximum in NOAA records. We ended the seven month (March-September) period with 6" more rain than normal. As a result, there was a dramatic increase in runoff and lake levels stayed at historical highs all summer.

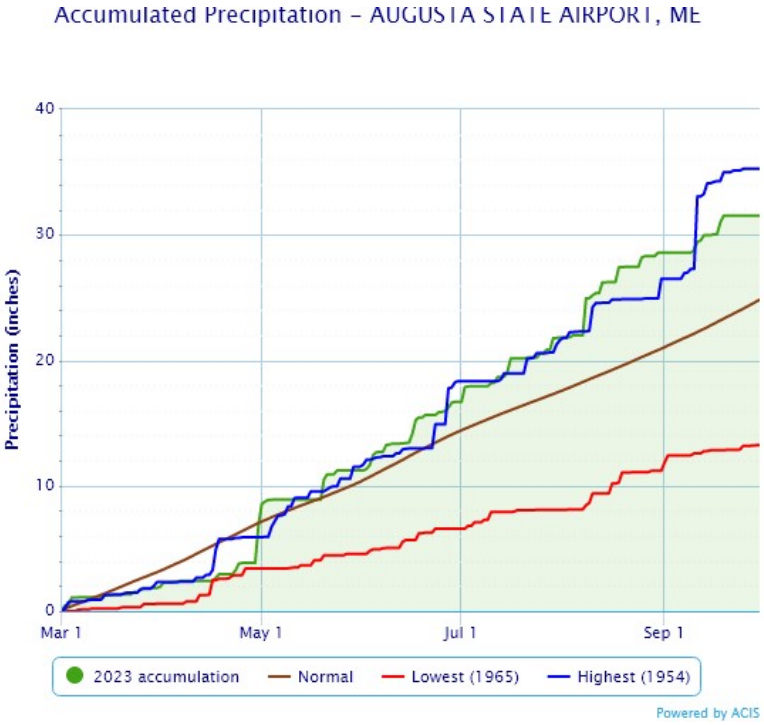


Figure 1—Accumulated Precipitation—Augusta

Temperatures for the same period were somewhat higher than normal, with early April, May, and early September having high peaks, while June, July and August were quite normal with the exception of a cold period in early June.

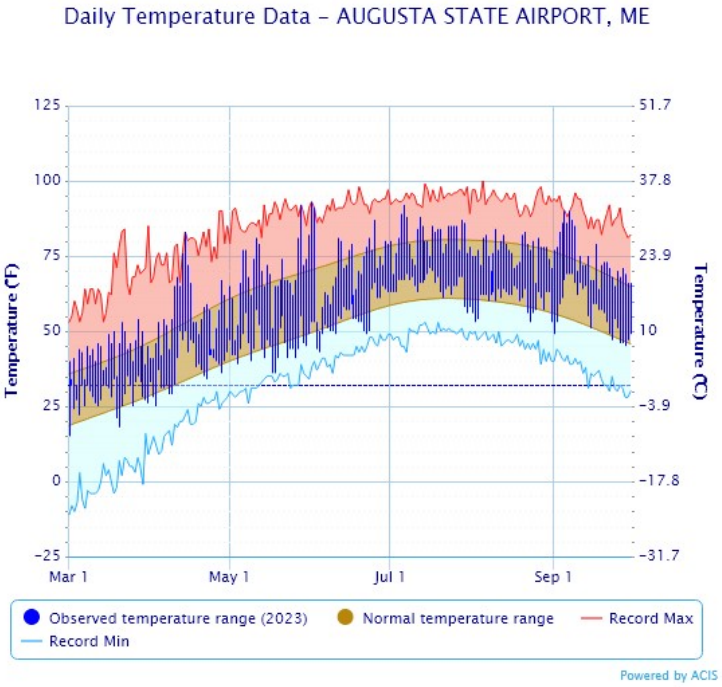


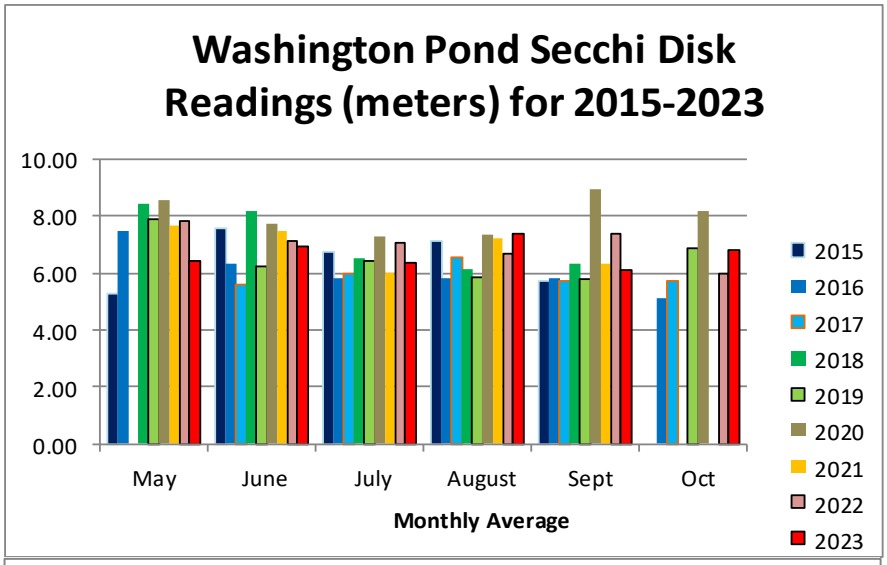
Figure 2

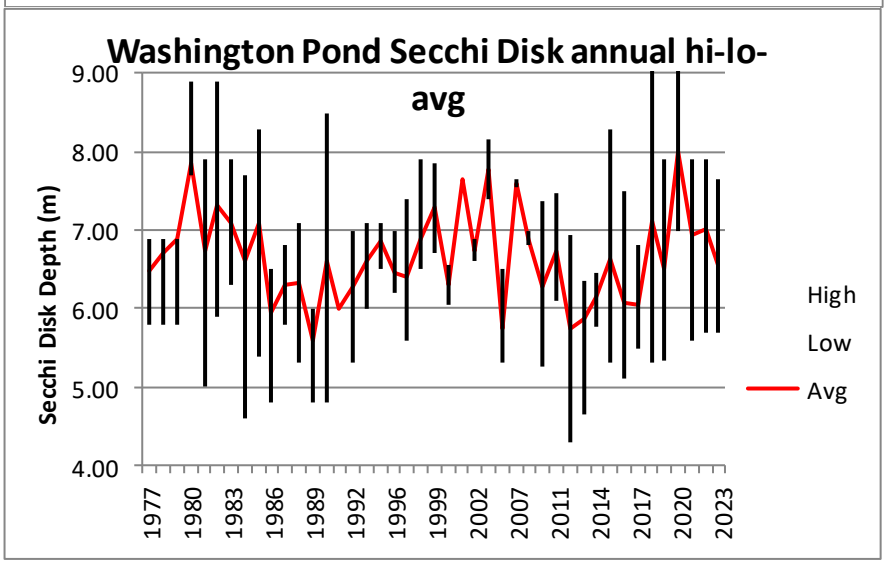
Temperature departure from historical average—

Washington Pond (Midas 4894)

Water Clarity

Secchi disk readings for Washington Pond in 2020 were the highest in the 45 years recorded. Subsequent years have slowly declined to 2023 which is about as normal a year as possible. Figure 3 shows the most recent 9 years for comparison and figure 4 gives high, low and average for the years since 1977. Having a normal year for clarity is interpreted as a good sign given the high precipitation and water levels all summer, clarity would be compromised if there was excess pollution (phosphorus) resulting in increased algae production.





Figures 3 and 4

Dissolved Oxygen

An adequate supply of dissolved oxygen in the water is essential to fish and other aquatic animals. If oxygen is low, fish, especially in the colder waters near the bottom, can be stressed. In addition, if oxygen levels at the very bottom are critically low for extended periods of time, it can promote the release of phosphorus trapped in bottom sediments to be re-introduced into the water, thereby increasing algae growth. We have the advantage that dissolved oxygen profiles have been taken for multiple years since the 1990's on Washington Pond. Measurements were taken four times each the summer of 2015 through 2017 and twice a month in 2018-2022 by the WLWA water quality team (2023 was actually every two weeks). The graph in Figure 5 shows the results of DO (dotted lines) and temperature (solid lines) readings in 2023. These are very consistent and show no significant anomalies..

Historical comparisons for five years of readings in mid to late August of dissolved oxygen and temperature with are in figure 6, with 2023 in black. Again, 2023 looks like a stable and normal year.

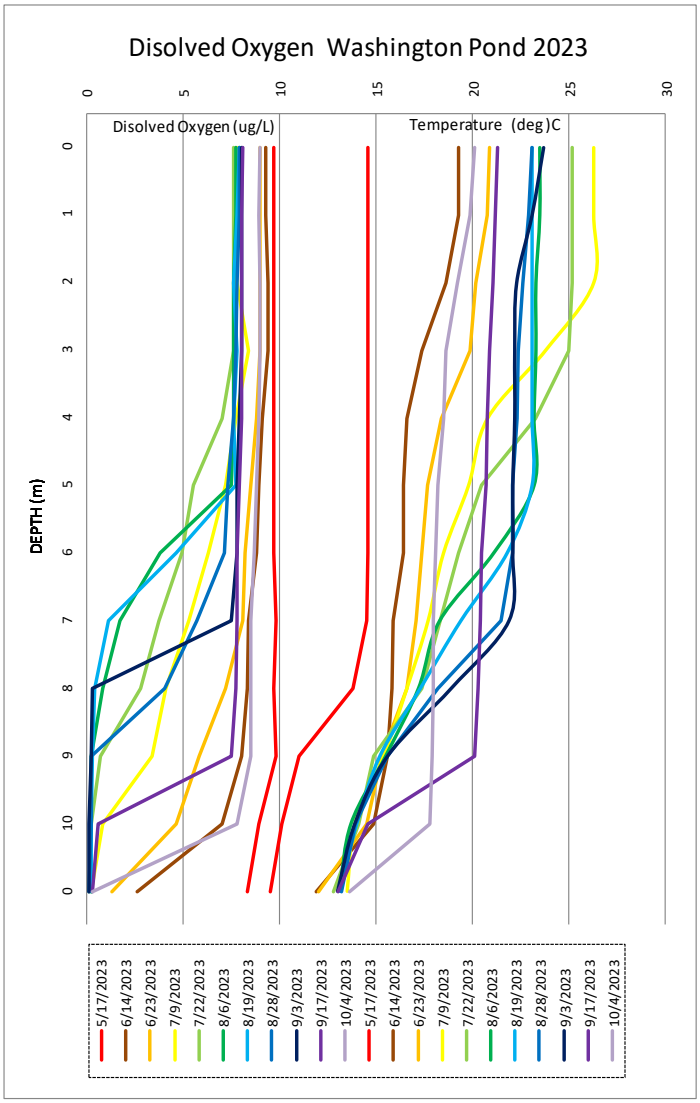


Figure 5

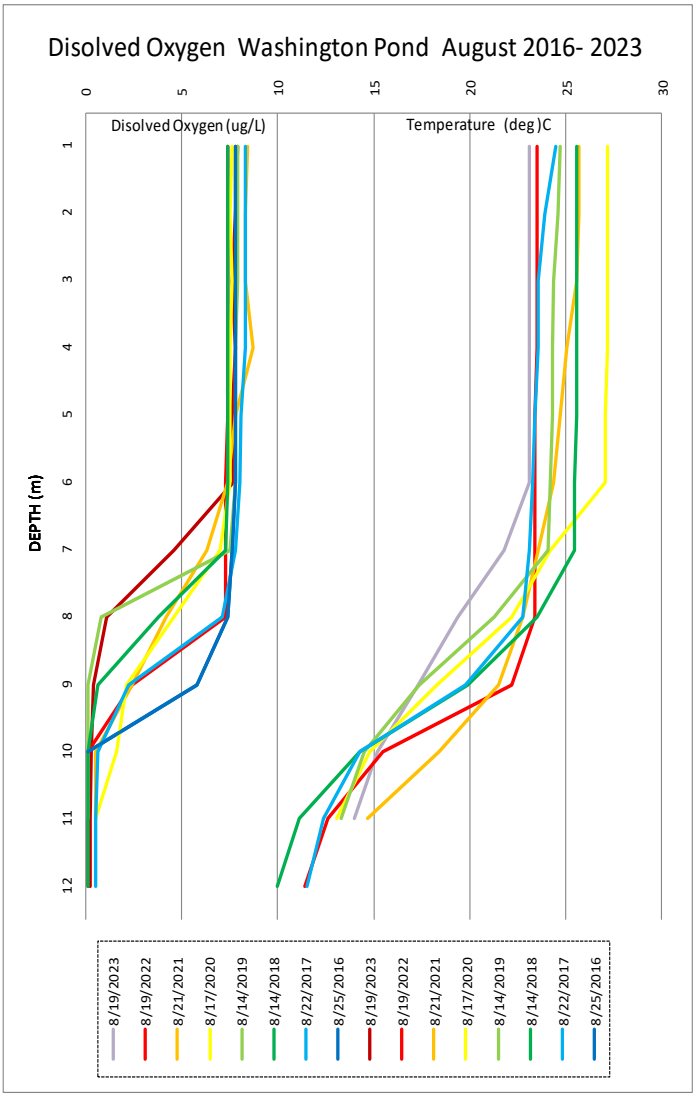


Figure 6

Phosphorus

A phosphorus sample (Figure 8) taken from the core water column (EC) sample measured 9 parts per billion (ppb). This sets a new high level reading and may be attributed to the high precipitation levels of 2023, increasing runoff from phosphorus laden soils. Bottom grab also high, but expected with higher core phosphorous

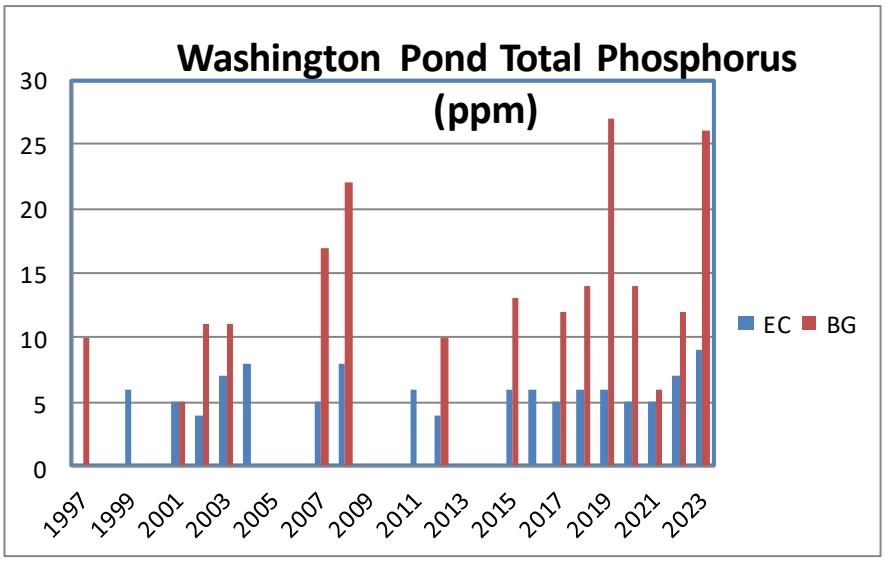


Figure 7

Chlorophyll a

Samples from a 10m core collection shows dramatically elevated Chlorophyl for 2023. This is likely attributable to the abnormally high water level and continued excess precipitation all summer. This is reinforced by the high phosphorus level (see next section) which would increase algae and chlorophyll production

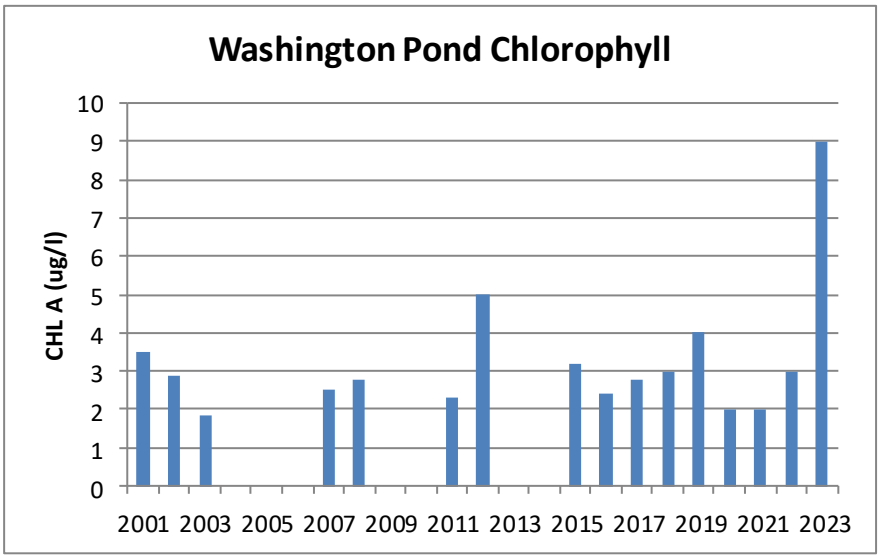


Figure 8

Midas 4894 Washington Pond Water Chemistry

							Long Term Reading thru 2023	
Parameter	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Low**	**High**	**Average**
Conductivity	36.4	38.9	39.7	41.4	42.7	52.9	24.0	52.9	42.0
Alkalinity	5.0	6.0	5	5	6	7	4.3	8.0	5.7
Color	7.0	12.0	6	7	6	13	5.0	15.0	8.5
pH	6.7	6.7	6.9	6.7	6.7	6.9	5.6	7.1	6.8
Chlorophyll-a	3.0	4.0	2	2	3	4	1.8	5.0	3.0
Phosphorus	6.0	6.0	5	5	7	9	4.0	9.0	6.3

Figure 9

Ph and Alkalinity

The pH of the core sample was 6.9, within average range and alkalinity was 7.0, also within historical range (see Figure 9 for data)

Conductivity

This also sets a new high, and again points to higher than normal runoff.

Color

This indicator of humic content was higher than normal trend, likely resulting from more leaf matter tannins introduced by runoff.

Commentary

2023 was an unusual year for Washington Pond. It is considered that the big difference in rainfall and resulting high water levels were the culprit, but as always we will look for whether the more abnormal readings continue with more normal precipitation. I do not feel that there is any significant or irreversible negative conditions in the lake.

Crystal Lake (Midas 4900)

After a unusual set of readings throughout the summer of 2019, Crystal returned to its typical condition in 2020-2022, and now 2023. This continues to be good news. Periodic sampling was restarted last year and continued this year.

Water Clarity

The Secchi disk reading (brown line, figure 10) was slightly lower than historical for the time of year, but combined with other measurements (below) indicate no cause for concern. Figure 11 indicates the historical comparison.

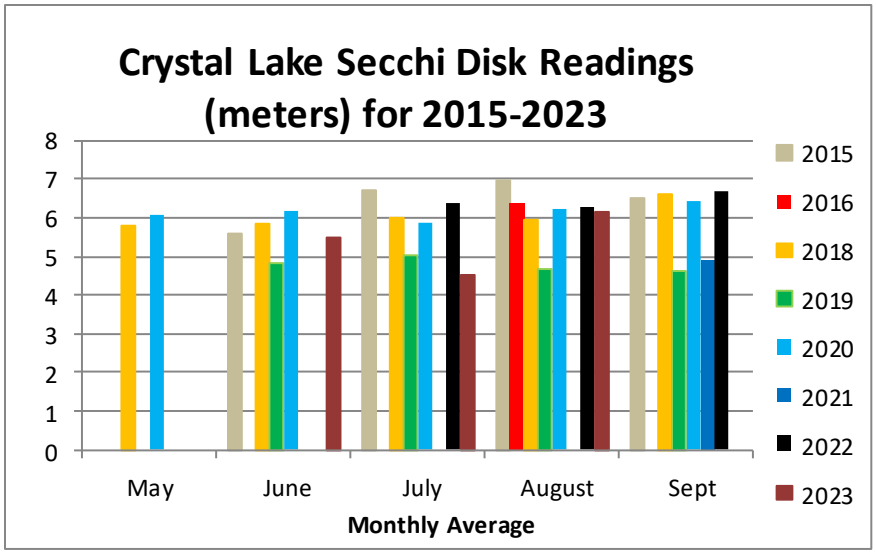


Figure 10

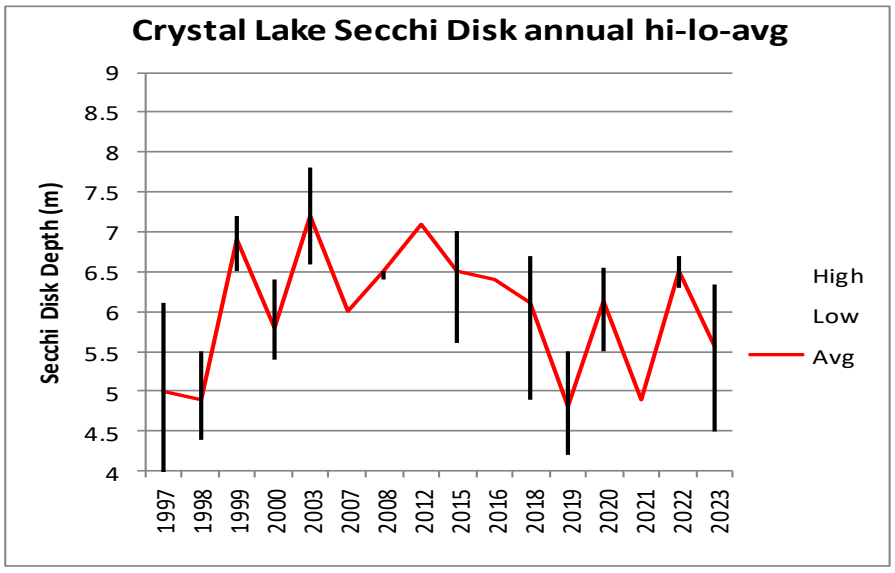


Figure 11

Dissolved Oxygen

An adequate supply of dissolved oxygen in the water is essential to fish and other aquatic animals. If oxygen is low, fish, especially in the colder waters near the bottom, can be stressed. If oxygen levels at the very bottom are critically low for extended periods of time, it can promote the release of phosphorus trapped in bottom sediments to be re-introduced into the water, thereby increasing algae growth. Figure 12 provides a comparison of historical data., 2023 (red, burgundy, pink, black lines) shows a different temperature/depth profile in the early readings (6/2 and 7/1) while later readings fall within the pack. Crystal was behaving unusually early in the season and then leveled out into normal. The lake may have turned over in an odd way, leaving some colder water at the top. The 6/2 reading also coincided with a cold snap in early June.

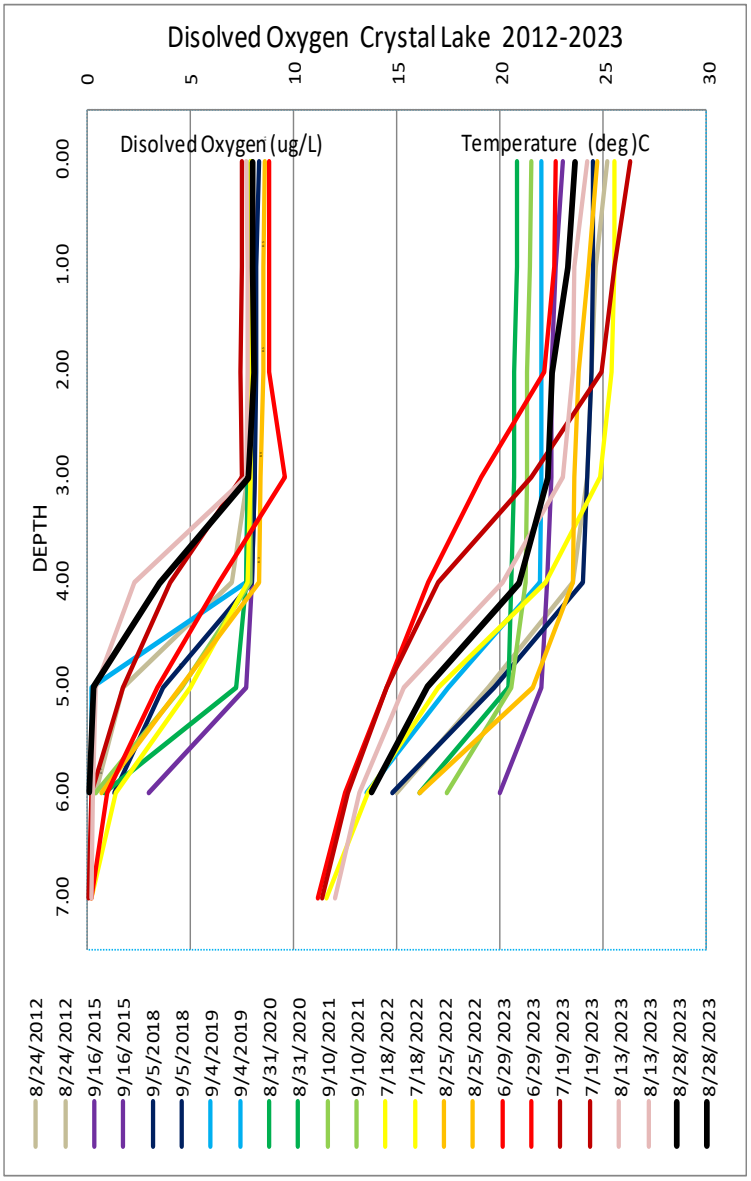


Figure 12

Midas 4900 Crystal Lake Water Chemistry

Parameter	2018	2019	2020	2021	2022	2023	Long Term Reading thru 2023 Low	High	Average
Conductivity	ls	51.0	53	53.8	55.8	52.9	51.0	55.8	53.3
Alkalinity	ls	5.0	5	4	4	6	4.0	6.0	4.8
Color	ls	20.0	13	14	12	27	8.0	30.0	17.2
pH	ls	6.8	6.7	6.6	6.7	7	6.4	7.0	6.8
Chlorophyll-a	2.0	5.0	2	4	4	5	2.0	5.0	3.7
Phosphorus	5.0	6.0	5	6	7	6	3.0	8.5	5.8

ls=sample lost or contaminated at HETL lab

Figure 13

Phosphorus

A phosphorus sample (Figure 8) taken from the core water column (EC) sample measured 6 parts per billion (ppb). Reasonably normal, despite the rain.

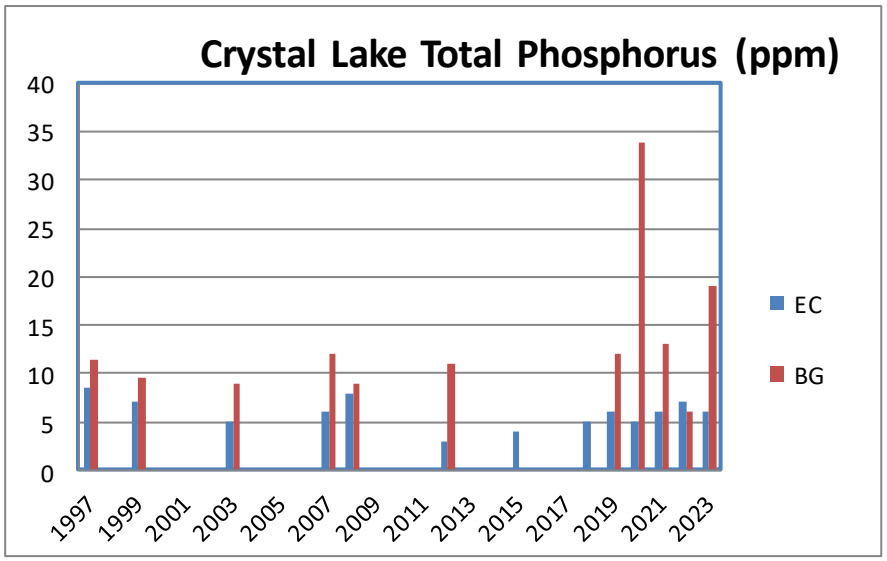


Figure 14

Chlorophyll-a

Samples from a 10m core collection shows dramatically elevated Chlorophyl for 2023. This is likely attributable to the abnormally high water level and continued excess precipitation all summer.

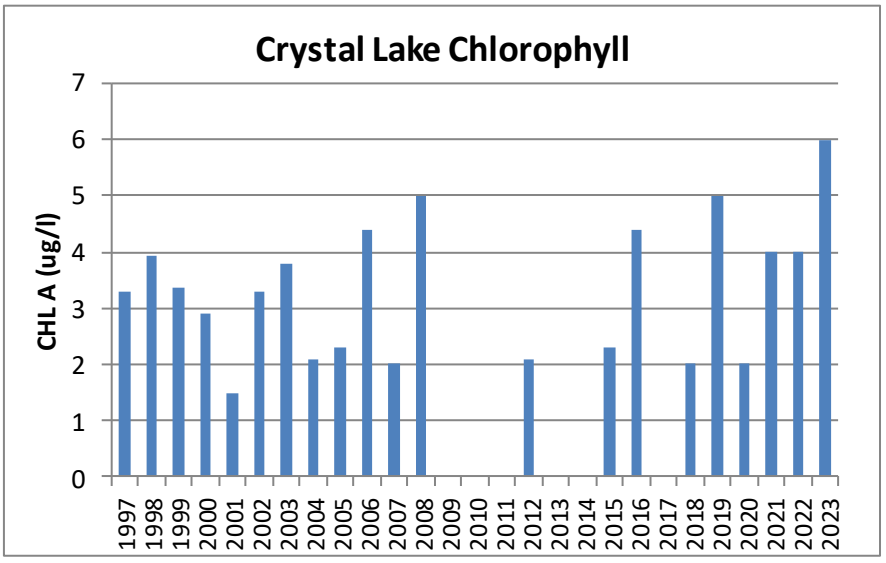


Figure 15

Conductivity

This measurement is an indicator of potential runoff pollution as it is an indicator for the amount of dissolved solids in the water. The readings are typical for 2023.

pH, Alkalinity

Measure of alkaline or acid state of the water, pH affects what plants find home in the lake. (Figure 17). Alkalinity is a measure of the ability of the lake to buffer changes to pH. Both have remained stable.

Color

This measures pigmentation due primarily to humus and tannins in the water. A higher level in 2023 is not unexpected with high water levels, promoting more foreign leaf matter to be included in the lake footprint, increasing tannic acid production.

Commentary

The result of 2020—2022 tests confirm that 2019 was an aberrational year for Crystal with three factors outside of normal ranges: Clarity, Dissolved Oxygen/Temperature profiles, and Chlorophyll-a. While 2023 shows some out of range readings , they are likely attributable to the high precipitation and resulting high water level in Crystal. This is a key to track in 2024.

Items Common to both lakes

Algae

Gloeotricchia echinulata, a planktonic blue-green algae that looks like small grains in the water, has been on the increase in Maine lakes in recent years. This phenomenon is not well understood. Gleo was sighted in Washington Pond for only about two weeks in late August of 2016, the first time it was recorded in Washington Pond. We encountered it in 2017 for a longer period of time, but in relatively sparse densities mid August to late September. 2018 it started occurring in early July and peaked in early September. By mid-September it was completely gone. In 2019-2022 it was sighted only once each year in very low concentration. Crystal had sparse population in 2018 and none in 2019-23.

Lakes Classification

Trophic State Index

Trophic State is a classification system to help determine whether a lake is oligotrophic (good water quality), mesotrophic, (fair water quality) or eutrophic (poor water quality). Various definitions can be found but typically the oligotrophic-mesotrophic line is somewhere between 40 and 50 on the TSI index. TSI can be based on three different parameters, Secchi Disk (SD readings, Chlorophyll-a readings, and Phosphorus levels. Figure below show recent data for both lakes. The average of all three is the best line to track.

This places both lakes in an Oligotrophic State with an anoxic hyperlimnia due to bottom oxygen depletion. We would like to see the TSI remain under 40. Above 40 would push our classification towards Mesotrophic and a lower overall water quality.

The down ward trend in Washington over the most recent three year period is concerning, but not alarming due to high precipitation levels in 2023. If the trend does not reverse with a more normal climatic year in 2024 then this provisional concern may become cause for alarm.

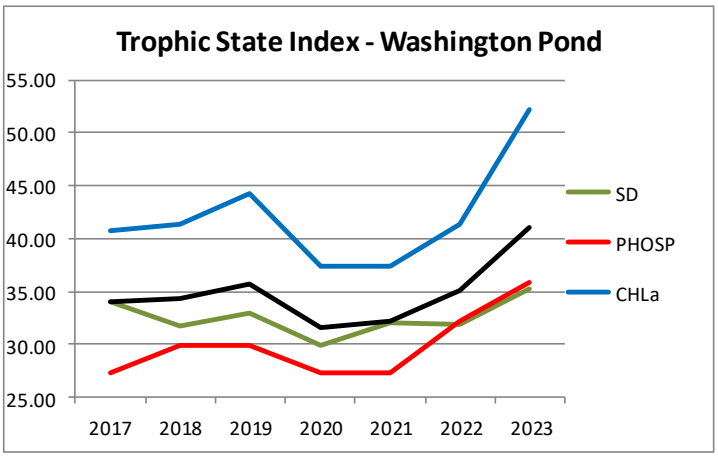


Figure 16

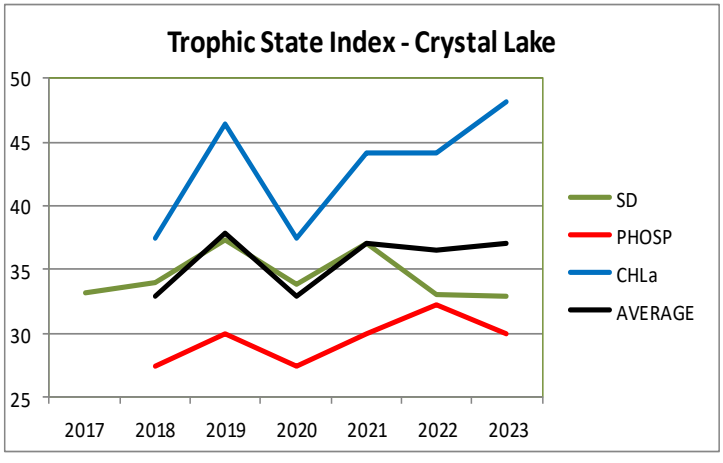


Figure 17

Conclusions

Both waterbodies test data is close to being within historical averages except for parameters thought to be unduly influenced by the high precipitation levels and high lake water level all summer. We compare very favorably with other Maine lakes. We are blessed with two very fine lakes in the Town of Washington, and we need to keep them that way. Water quality is affected by many things, and climate change is one. This is evidenced in the changes which are attributed to extreme precipitation and high water levels. We cannot control these, however, there are things which we, as residents, can control. One is to limit any runoff directly into the lake. This occurs frequently where unpaved launch sites approach the water's edge. Sand and silt contains naturally occurring harmful phosphorous and this can and does affect water quality. Another is maintaining a good buffer between our land use and the lake. A border at least 25 feet of natural plantings, low bushes, trees, (NOT grass) is very important. We have many steep hillsides leading to the lake, and slowing down water rivulets that are destined for the lake can greatly reduce the pollution of the lake.

For Washington Pond, Secchi Disk readings (transparency) were consistently at the normal to high (good) range of historical data. Dissolved Oxygen tests were within normal range. Chlorophyll and phosphorus were high (not good) but not unexpected with warmer water (surface temps peaked early in July and stayed warm all summer). Higher runoff (substantiated by higher than normal conductivity, contributes to these elevations also. If, however, the downward quality trend does not reverse in 2024, these can be a cause for alarm. See TSI comments on page 16).

Crystal Lake has always behaved differently: Secchi was lower early to mid-summer but regained high readings late August. Temp profile also skewed in early part of summer. Chlorophyll was high (as it was in Washington Pond) but phosphorus was right on normal.

Conclusions: Nothing alarming to report or be worried about. Let's hope that we get a more normal climatic summer in 2024. This will tell us a lot about the ability of our lakes to withstand significant changes.

In addition although we have found Chinese Mystery Snails, we do not have any known vegetable invasive species in the lake. This remains only as we are diligent in not bringing them into the lake on boats or trailers during launch and retrieval. *We should have an invasive plant patrol for our lakes,* and we need volunteers to step up and start this important preventative operation on our lakes; it can be a fun and social event along with doing important work. Please, if you can, volunteer to help. Training and education is available, and you don't have to do everything yourself.

We are always looking for Citizen Scientists to step up and help with water testing and littoral and shoreline invasive surveys. In 2023 we welcomed Anne Jenkins and Scott Edwards to the Water Test Team, with training provided by Lake Stewards of Maine. They are proving to be a great help, both in data collection and in asking great questions. Come, join us, and have fun on our wonderful lakes.

Roger C. Cady
February 2024