2022 Washington Lakes Water Quality Report

Prepared January 2023

By

Roger C. Cady
WLWA Water Quality Monitor

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

Index to Washington Lakes Water Quality Report 2022

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

Appendix I - Water Quality Indicators and Their Measurement

Courtesy Lake Stewards of Maine

Appendix II Distribution of Water Quality Data in Maine Lakes

Courtesy of LSM and Maine DEP

Appendix III - Dissolved Oxygen and Lake Turnover

Courtesy of Water on the Web Website

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 eighth report in that series. 2022 continues to add to the comprehensive data set created by WLWA, certified by LSM and accepted into the State of Maine database maintained by the Department of Environmental Protection (DEP).

Washington Pond (Midas 4894)

Washington Pond continues in good shape for 2022. In 2020 it displayed the consistently highest secchi disk readings (clearest water) since the start of our database in 43 years ago. This year was not as high, but above normal ranges. Other parameters were also well within normal.

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.

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. Chlorophyll an indicator of algae was same as last year within historical range. The dissolved oxygen was in the within historical norms. Thus, from a water chemistry standpoint, the lake and fishery appears to once again maintain normal conditions.

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 we had only no abnormally large events and a lower than normal precipitation. Overall, average temperatures were around 1.5F above historical average; there were spikes of heat (setting a new record in Augusta) in May and periods of unusually cool in June. The lakes withstood these well.

Invasive Species

There were no invasive **plant species** in either lake in 2022 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.

Location Buoy

Consistency of sampling is key to understanding longer term trends. In 2022 a buoy was installed in Washington Pond to assure that the sampling location was correct. Unfortunately over the course of the summer it was several times removed or relocated, presumably as a joke. Because of this, our comprehensive chemistry sampling for 2022 could be questioned as it was not on proper location. This is serious and we ask that in 2023 the Buoy be left undisturbed to assure compliance with Maine DEP requirements.

Volunteers for Citizen Science

Last year's call for volunteers was responded to in a most positive way. Jeff Grinnell and Scott Edwards became trained and certified monitors, while Anne Jenkins who missed certification due to COVID was on the water several times helping Scott and me. My thanks to Scott for taking over measurements when I was away, and particularly to Patricia Nease of Midcoast Conservancy for collecting this years comprehensive chemistry samples.

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

January 2023

*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 2022

Sampling Methodology

During the 2022 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 and hope to expand this in 2023 with our newly trained volunteers. In addition, as has been customary, in late August or early September we take comprehensive 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 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 and can expand in 2022. In particular, a close relationship with Midcoast could 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, 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 temperature stresses the fish. Furthermore, depleted oxygen at the bottom of a lake facilitates an anoxic process that causes the phosphorus cap-

tured and 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. 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

Our comprehensive tests provide that we collect water samples for laboratory analysis in two ways. The first is we collect water from a column of water from surface to within a couple of feet of the bottom. This sample of water from all depths is called the Core sample. In addition, a sample of water is collected only from just above the bottom (bottom grab) to provide an analysis of the element phosphorus near the bottom .

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

Phosphorus (partial determinant potential for algae growth). (Core and bottom samples)

Chlorophyll-a (indicator of algae and other microscopic plant materials present)

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 affects water clarity)

2022 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). Rainfall was normal for the first four months of the year, and then dropped to slightly below normal over the summer period. There were no single large rain events measured in Augusta (figure 1), which we use as a reasonable proxy for the Washington area, although we know that summer storms can vary widely over this area. A hot spike in May was followed by cooler than seasonal June. Average temperatures over the summer were approximately 1.5 degrees F above normal. Figure 2 provides a display of temperature.

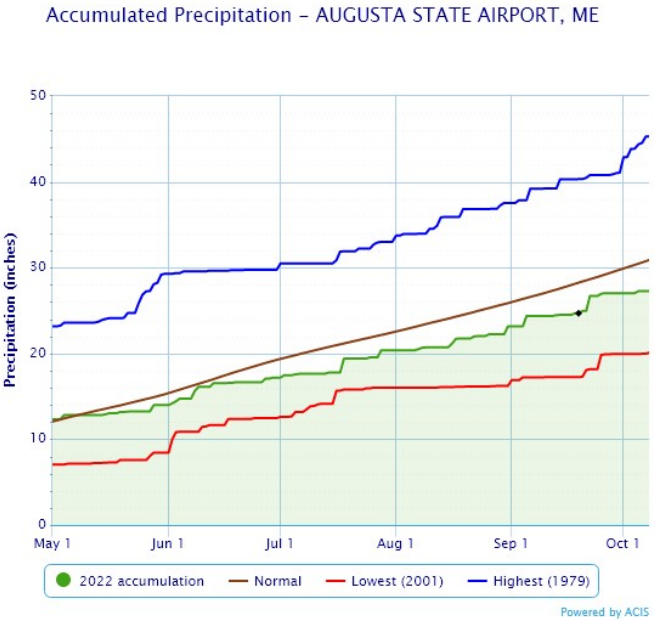


Figure 1—Accumulated Precipitation—Augusta

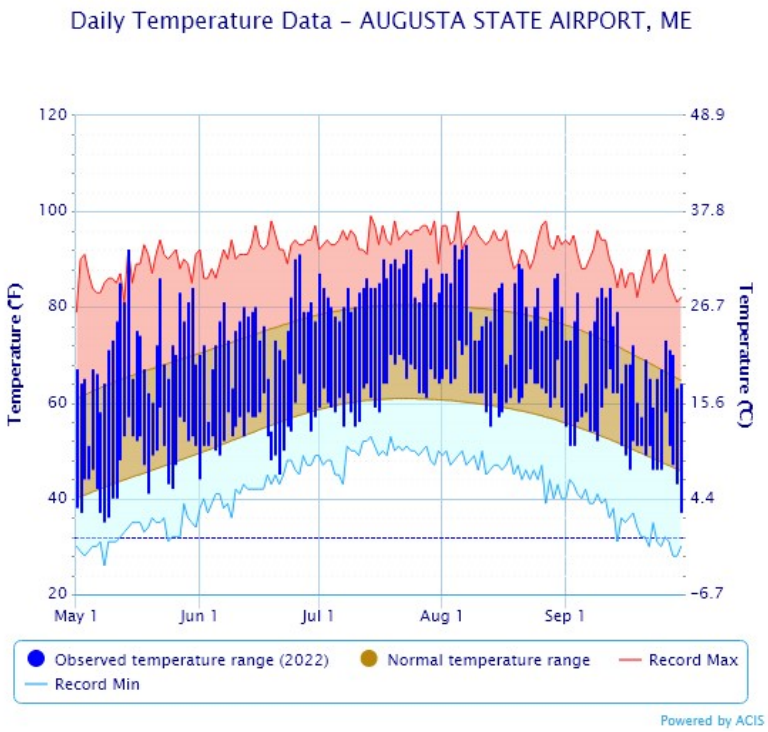


Figure 2
Temperature departure from historical average—Augusta 2022

Washington Pond (Midas 4894)

Water Clarity

Secchi disk readings for Washington Pond in 2020 were the highest in the 45 years recorded. 2022 were slightly above the average throughout the summer. Figure 3 shows monthly average comparisons with 2015-2021. Figure 4 shows readings on a monthly average over past years.

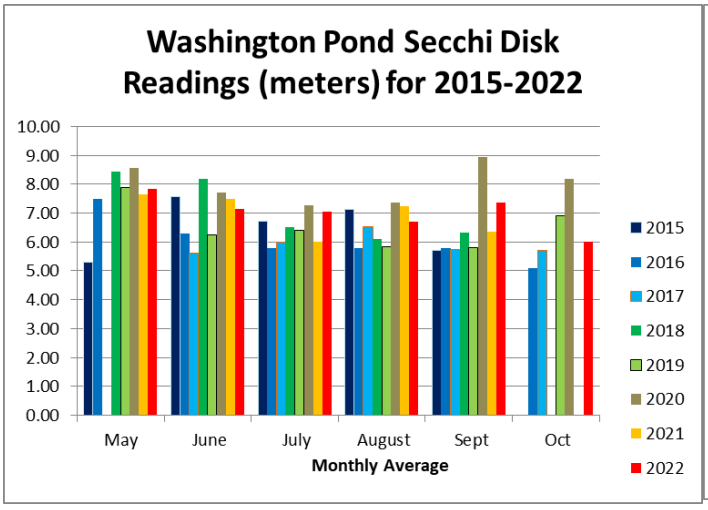


Figure 3

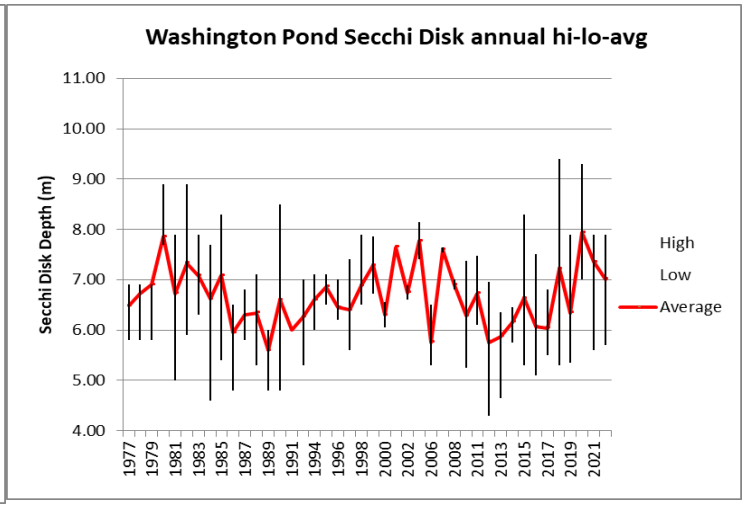


Figure 4

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. 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. The graph in Figure 5 shows the results of DO (dotted lines) and temperature (solid lines) readings in 2022. 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 2022 in black. Again, 2022 looks like a stable and good year.

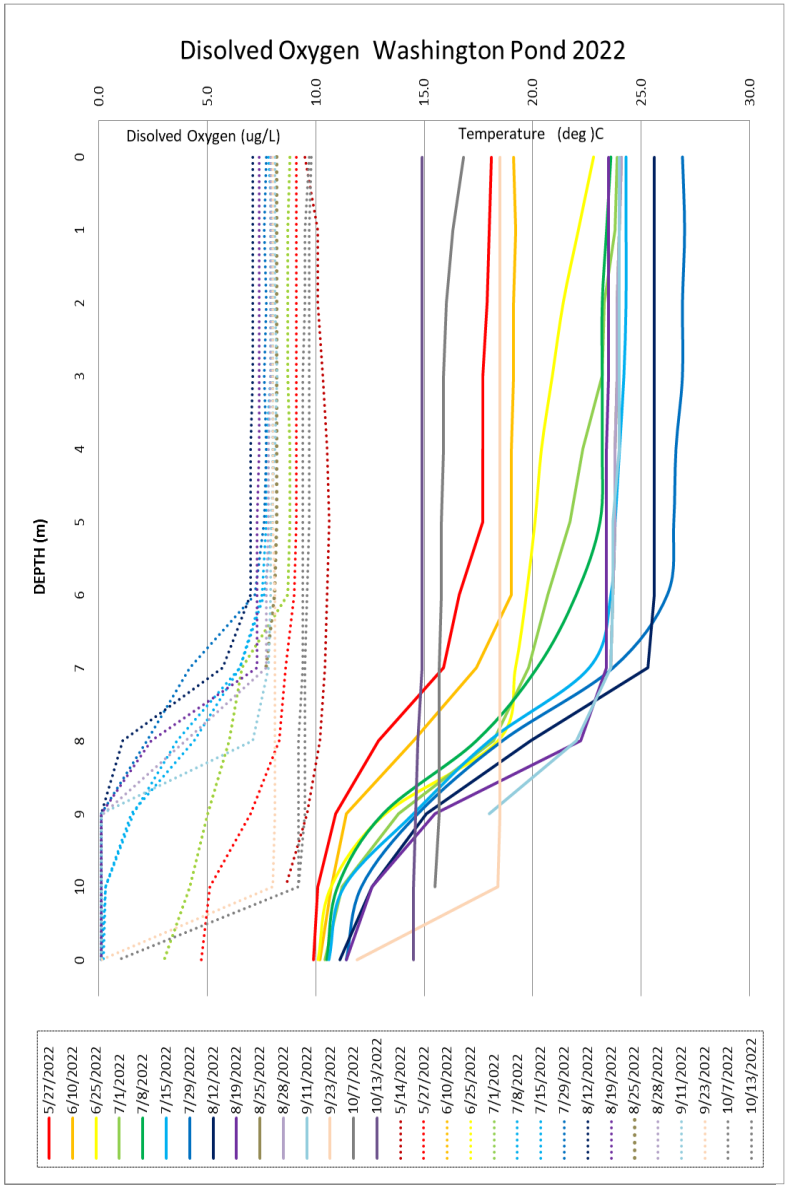


Figure 5—2022 Results

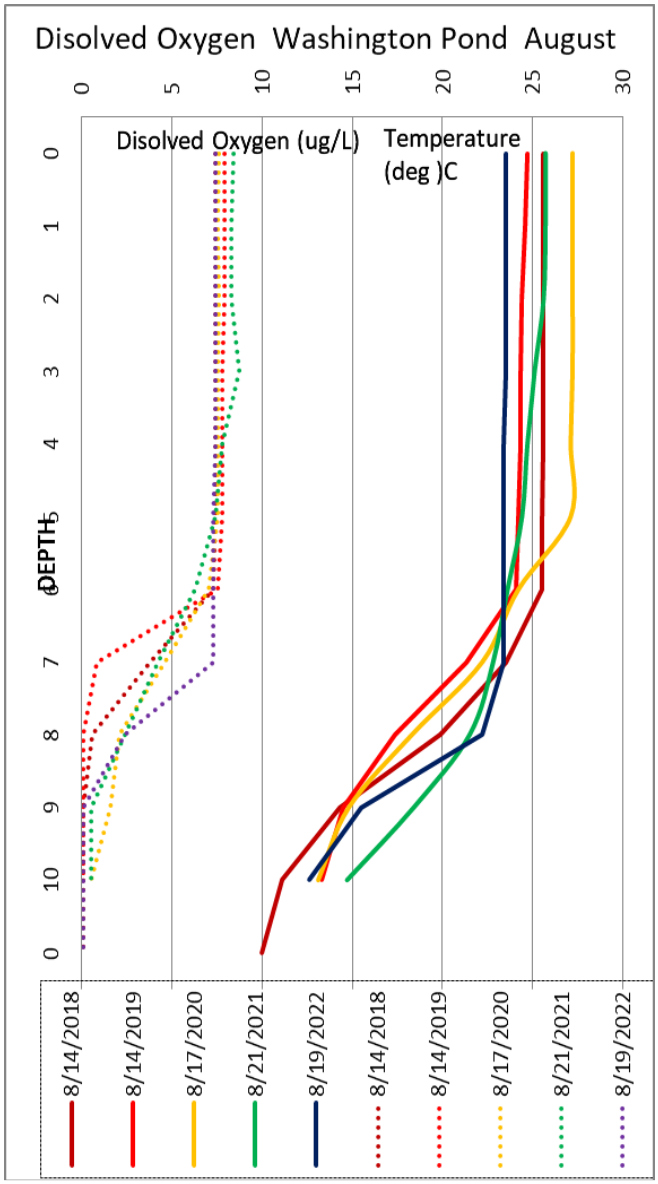


Figure 6—Five Year DO Comparison

Chlorophyll a

Samples from a 7 meter core sample in 2022 showed Chlorophyll at 3.0 ug/l, (Figure 7) fairly typical of past readings and in line with a normal to slightly below normal rainfall.

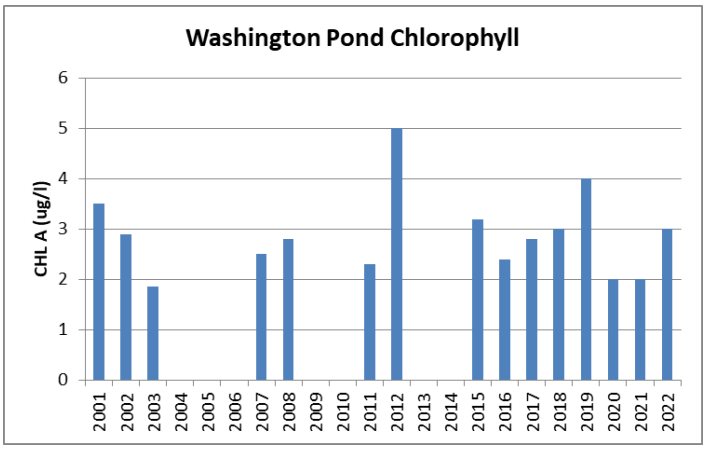


Figure 7

Phosphorus

A phosphorus sample (Figure 8) taken from the core water column (EC) sample measured 6 parts per billion (ppb), close to historical average of 5.7 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 have been associated with algal blooms in some Maine lakes, these continuing lower sample concentrations are a good trend. 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.

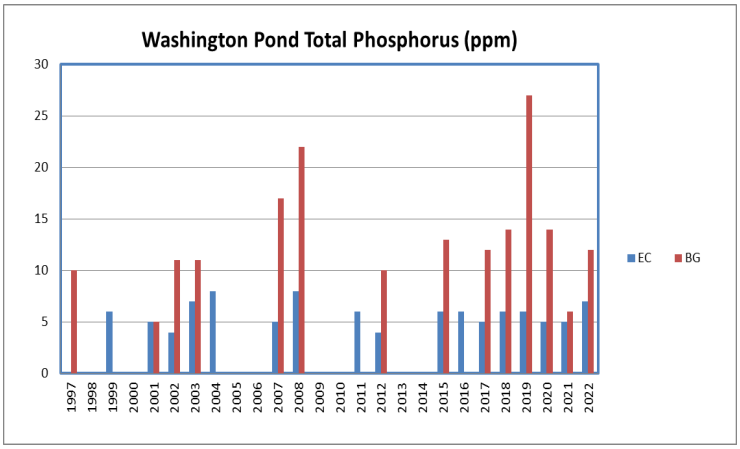


Figure 8

Midas 4894 Washington Pond Water Chemistry

Parameter	2018	2019	2020	2021	2022	Long Term Readings thru 2022 Low	High	Average
Conductivity	36.4	38.9	39.7	41.4	42.7	24.0	40.0	34.0
Alkalinity	5.0	6.0	5	5	6	4.3	8.0	5.0
Color	7.0	12.0	6	7	6	5.0	15.0	7.0
pH	6.7	6.7	6.9	6.7	6.7	5.6	7.1	6.6
Chlorophyll-a	3.0	4.0	2	2	3	1.8	5.0	2.8
Phosphorus	6.0	6.0	5	5	7	4.0	8.0	5.8

Figure 9

Ph and Alkalinity

The pH of the sample was 6.7, within average range and alkalinity was 6.0, also within historical range (see Figure 9 for data)

Color

This indicator of humic content was lower than normal at 6, likely resulting from lower runoff of humus pollution.

Commentary

In general, Washington Pond continues to be quite stable with water quality very good. No significant issues were uncovered in 2022. Low oxygen bottom conditions promote anoxic release into the water column of phosphorous that is bound in the bottom sediments and increases potential for higher bio-productivity of the lake. *This is a balance we must watch if climate change affects bio-productivity and hence oxygenation.*

Crystal Lake (Midas 4900)

After a unusual set of readings throughout the summer of 2019, Crystal returned to its typical condition in 2020, 2021, and now 2022. This continues to be good news. Periodic sampling was restarted this year.

Water Clarity

The Secchi disk reading (black 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.

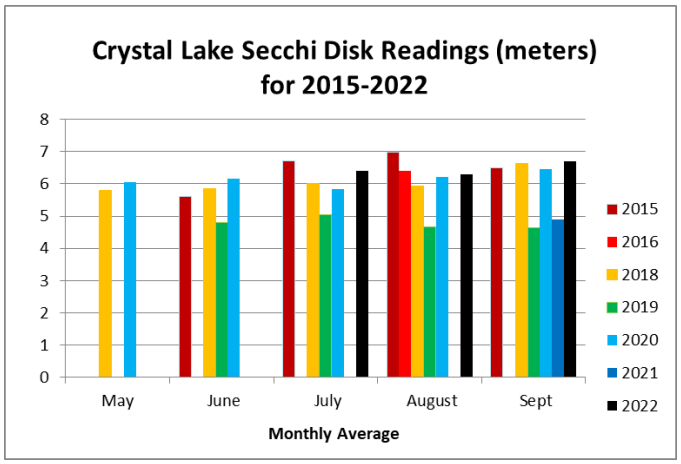


Figure 10

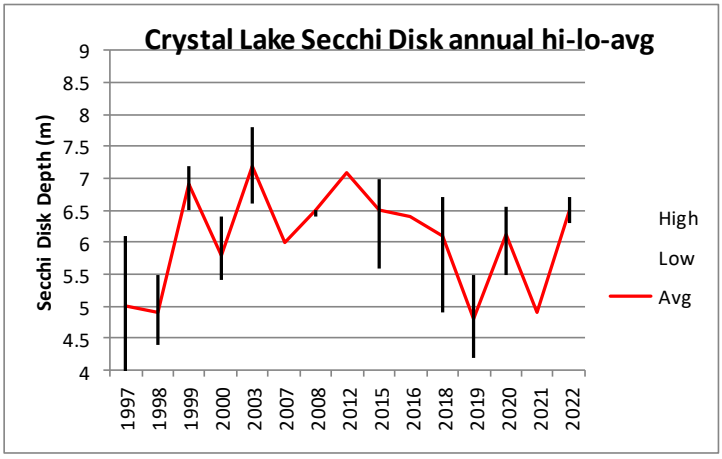


Figure 11

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, and it is clear that 2022 (black lines) is back in center of the historical pack.

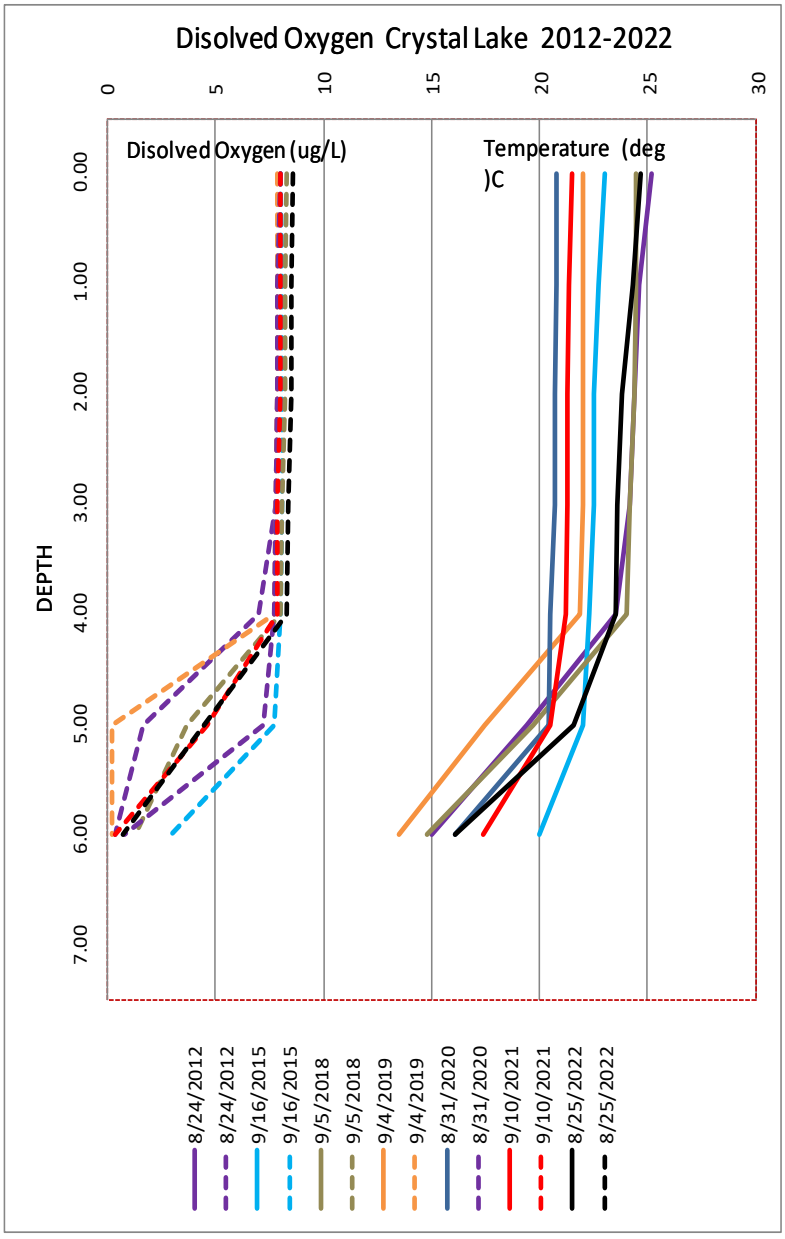


Figure 12

Chlorophyll-a

Measurements of chlorophyll indicate amount of green pigment found in all plants and therefore is an indicator of amount of algae in the water. Figure 13 indicates these readings since 1997, with 2020 being on the low side. This indicates low algae production.

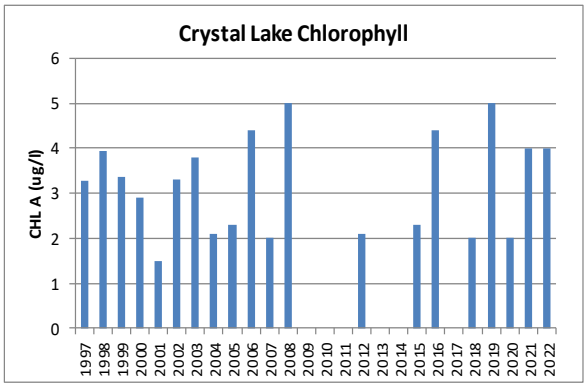


Figure 13

Phosphorus

Both readings of this element (Figure 14) in the water column (blue) are within historical ranges. The bottom sample (red) was low in 2022 (lower is better). The 2020 abnormal bottom sample is thought to be due to a sampling error which may have stirred up sediments.

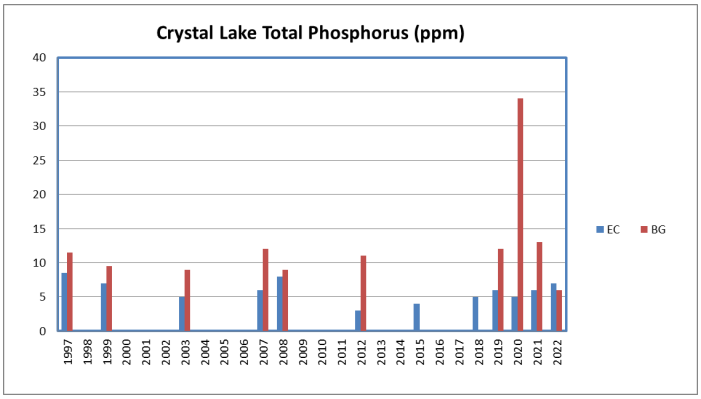


Figure 14

Midas 4900 Crystal Lake Water Chemistry

Parameter	2018	2019	2020	2021	2022	Long Term Reading Low	High	Average
Conductivity	ls	51.0	53	53.8	55.8	51.0	55.8	53.4
Alkalinity	ls	5.0	5	4	4	4.0	5.8	4.3
Color	ls	20.0	13	14	12	8.0	30.0	12.0
pH	ls	6.8	6.7	6.6	6.7	6.4	6.9	6.6
Chlorophyll-a	2.0	5.0	2	4	4	2.0	4.2	3.1
Phosphorus	5.0	6.0	5	6	7	3.0	8.5	6.1

ls=sample lost or contaminated at HETL lab

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 2022.

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. Right on average.

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. *2022 continues to be normal for Crystal Lake.* It is good to see that the lake has recovered from whatever affected it in 2019.

Items Common to both lakes

Algae

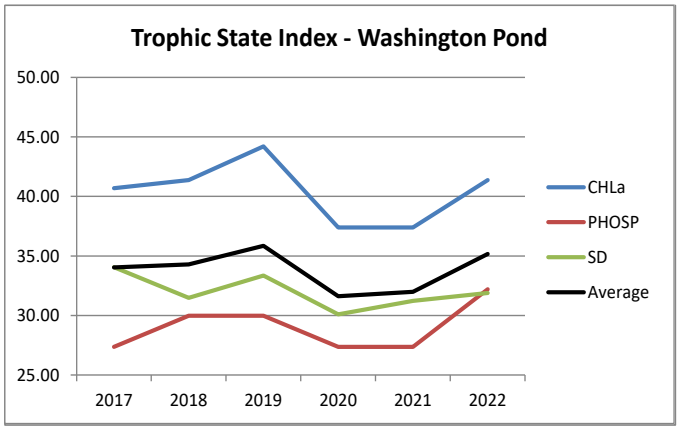
Gloeotricchia echinulata, a planktonic blue-green algae that looks like small grains in the water, has been on the increase in Maine lakes in recent years. This phenomenon is not well understood. Gleo was sighted in Washington Pond for only about two weeks in late August of 2016, the first time it was 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 2019-22.

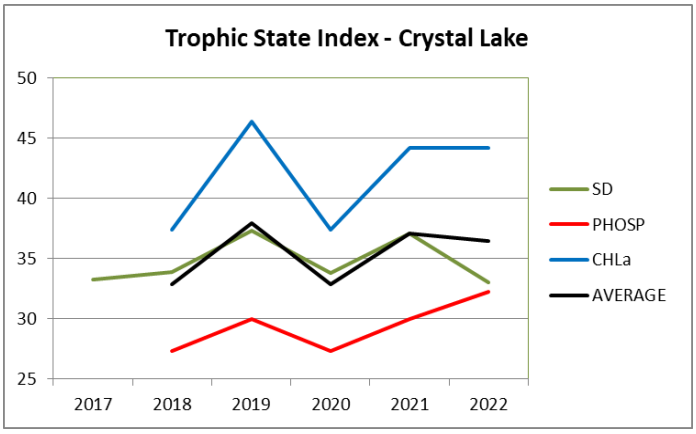
Lakes Classification

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 18 and 19 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.





Conclusions

Both waterbodies test data is normal (within historical averages) and 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 will no doubt be one. 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.

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 (assuming the pandemic continues to be past history in summer 2023) 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.

Roger C. Cady
January 2023