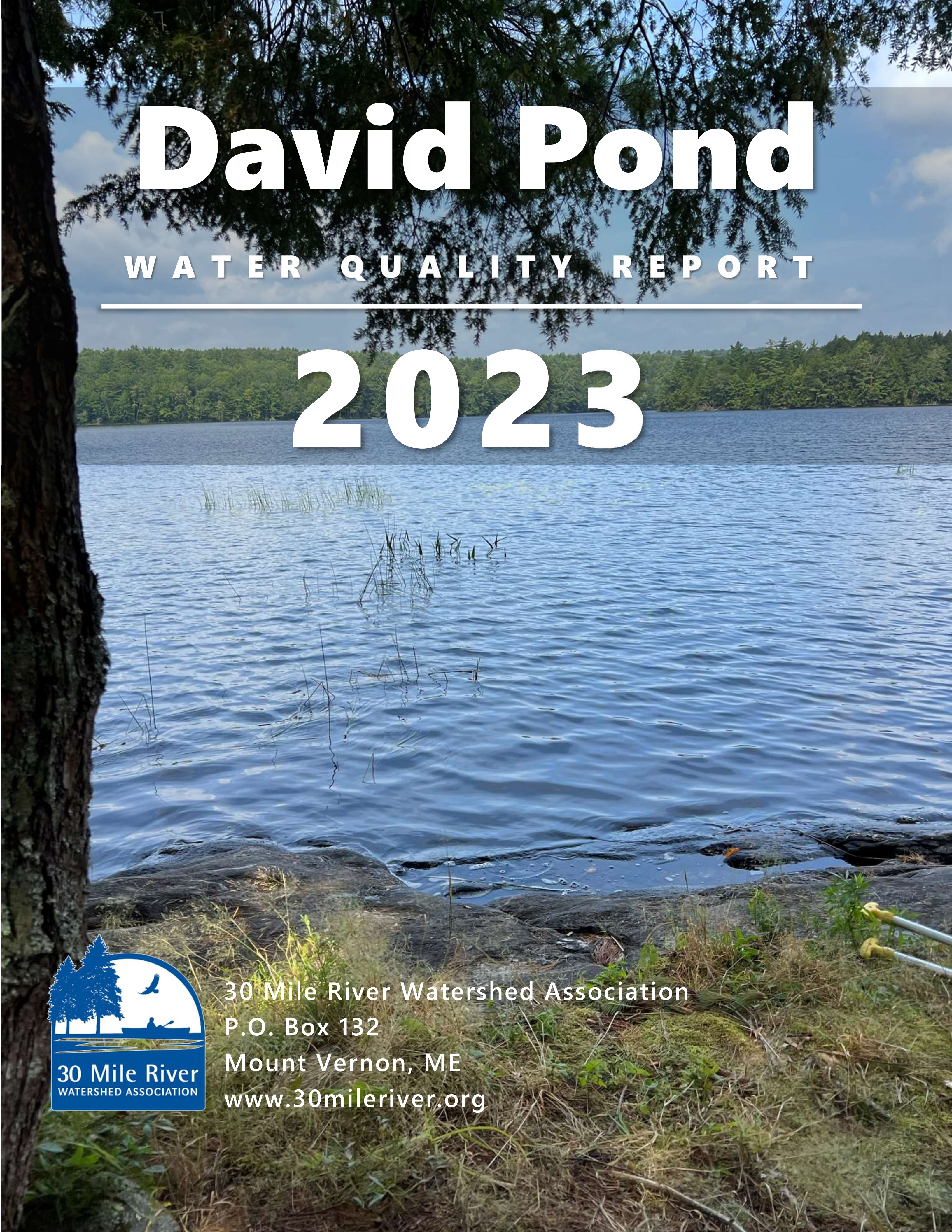

David Pond

WATER QUALITY REPORT

2023

30 Mile River Watershed Association
P.O. Box 132
Mount Vernon, ME
www.30mileriver.org

2023 David Pond Water Quality Report

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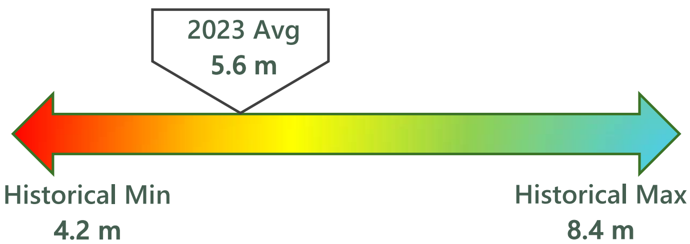
Monitoring on David Pond occurred on ten dates between May and October 2023 by Whitney Baker and Silas Mohlar of 30 Mile River Watershed Association (30 Mile).

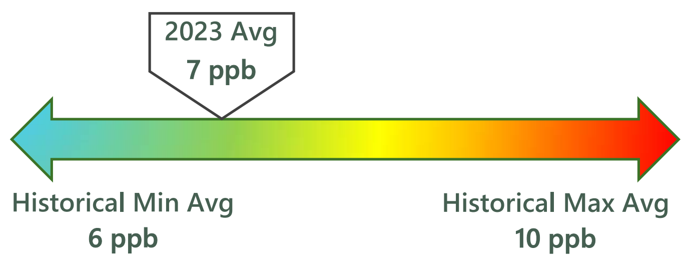
Water clarity readings in 2023 ranged from 4.9 meters (July 13th) to 6.8 meters (May 31st) with an annual average of 5.6 meters. A total of 14 readings were collected in 2023.

Water Clarity (m)	
2023 Water Clarity Average	5.6
Historical SDT Average	5.8
Maine Lakes SDT Average	4.8



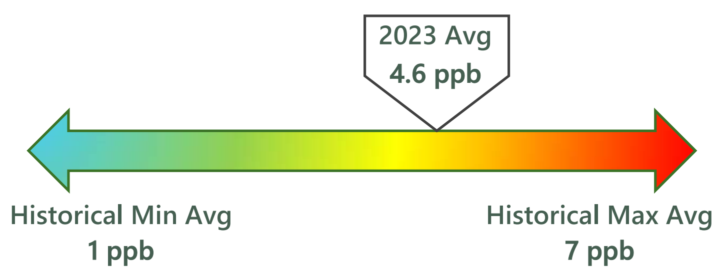
Five (5) samples were collected and analyzed for **Total Phosphorus**. Laboratory results ranged from 6 ppb (parts per billion) to 8 ppb with an average of 7 ppb.

Total Phosphorus (ppb)	
2023 TP Average	7
Historical TP Average	7
Maine Lakes TP Average	12



Chlorophyll was measured five (5) times in 2023. Results ranged from 3 ppb to 7 ppb with an annual average of 4.6 ppb.

Chlorophyll-a (ppb)	
2023 Chl-a Average	4.6
2023 Peak Chl-a	7
Historical Chl-a Average	3.6
Maine Lakes Chl-a Average	5.4



Ten (10) **Dissolved Oxygen (DO)** profiles were collected in 2023. Anoxia (DO <2 ppm) was first encountered in waters 11 meters and deeper in May, but this zone of anoxia grew to include all

[1] Scale bars illustrate the range of data collected for each parameter over the historical monitoring record for general comparison with the 2023 monitoring results. The blue end represents the historical minimum (best), and the red end represents the historical maximum (worst) of all monitoring data collected.

waters 5 meters in August and much of September and persisted in waters 7 meters and deeper in late September through mid October.

Overview

David Pond is located in the town of Fayette in Kennebec County, Maine and has a direct watershed drainage area of just over 2 square miles, and an indirect upstream watershed of approximately 2 square miles, which includes the drainages of Tilton and Basin Ponds. David Pond has a single outlet located at the north end of the northern basin that crosses Sandy River Road in Chesterville and continues into Parker Pond.

David Pond is a relatively shallow lake with a maximum depth of 11 m (37 ft) and an average depth of just 3 m (10 ft). The Pond has a surface area covering approximately 300 acres. David Pond does not have a public boat launch.

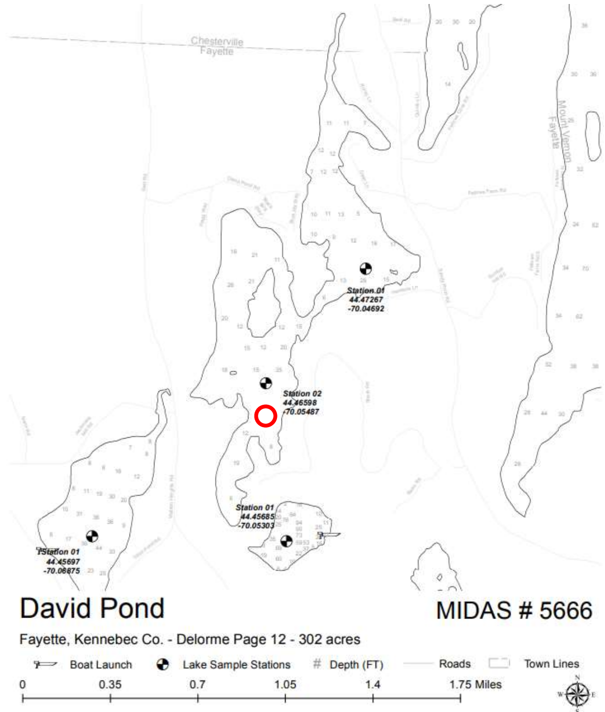


Figure 1. David Pond Monitoring Stations, Maine DEP.

Water Quality Monitoring in 2023

Water quality monitoring on David Pond takes place at the deepest spot in the lake (Maine DEP Station 2), also known as the “deep spot”, located in the south basin. Station 2 is just over 11 meters (37 ft) deep (Figure 1). Monitoring in 2023 was completed by Whitney Baker and Silas Mohlar of 30 Mile River Watershed Association (30 Mile). A special thanks to our 2023 water quality volunteers on David Pond:

David Pond on September 5th, 2023

Kirstie Ludwig &
Bob Harradon

Water quality data was collected on nine dates between May and October. Parameters include Secchi disk transparency, dissolved oxygen and temperature, phosphorus, chlorophyll, and advanced chemistry parameters (pH, Alkalinity, Color, and Conductivity).

Secchi Disk Transparency (Water Clarity)

Secchi disk transparency (SDT) is an indicator of water clarity. To measure water clarity, a black and white disk is lowered into the water and the reading is taken at the depth at which it is no longer visible. Factors that affect water clarity include algal growth, zooplankton densities, natural water color, and suspended silt or sediment particles.

Water Clarity (m)	
2023 Water Clarity Average	5.6
Historical SDT Average	5.7
Maine Lakes SDT Average	4.8

Water clarity readings in 2023 ranged from 4.9 meters (July 13th) to 6.8 meters (May 31st) with an annual average of 5.6 meters. 14 total readings were collected over 10 monitoring days in 2023 (Figure 2).

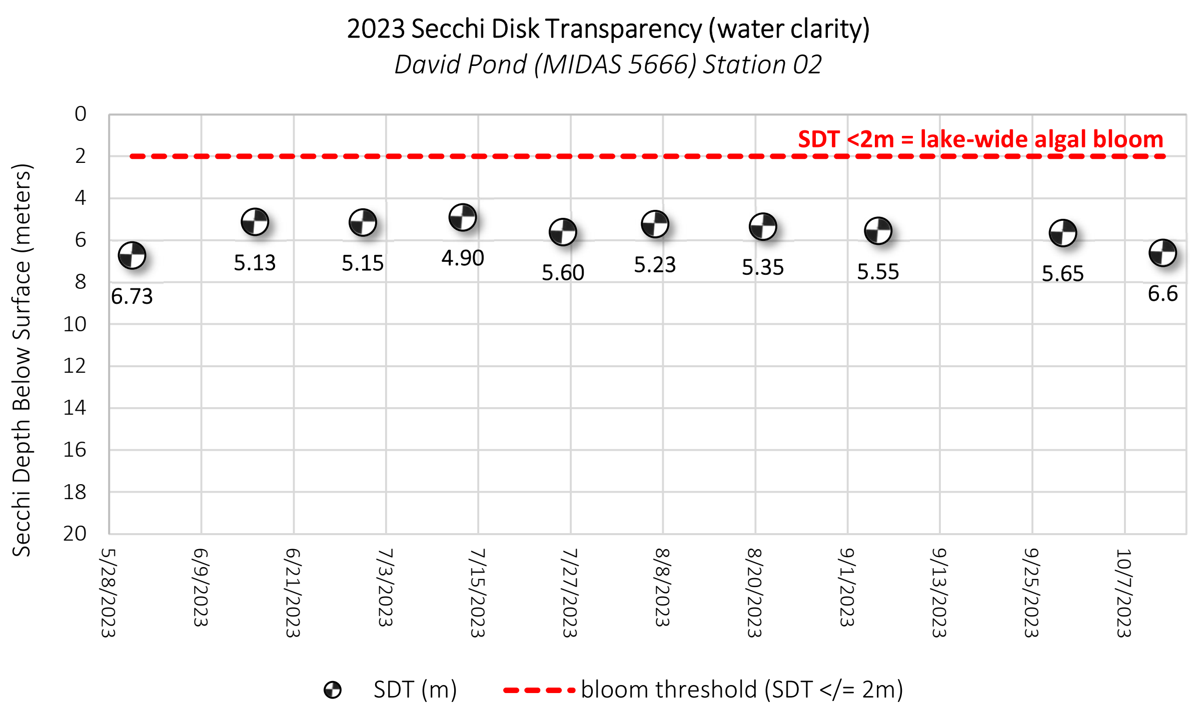


Figure 2. 2023 Secchi Disk Transparency Daily Averages, Station 2

SDT data has been collected during 19 years throughout the historical monitoring period spanning the past 41 years. Historically, SDT readings in David Pond have ranged from 4.2 m (2019) to 8.4 m (2022) with a historical average of 5.8 m (Figure 3).

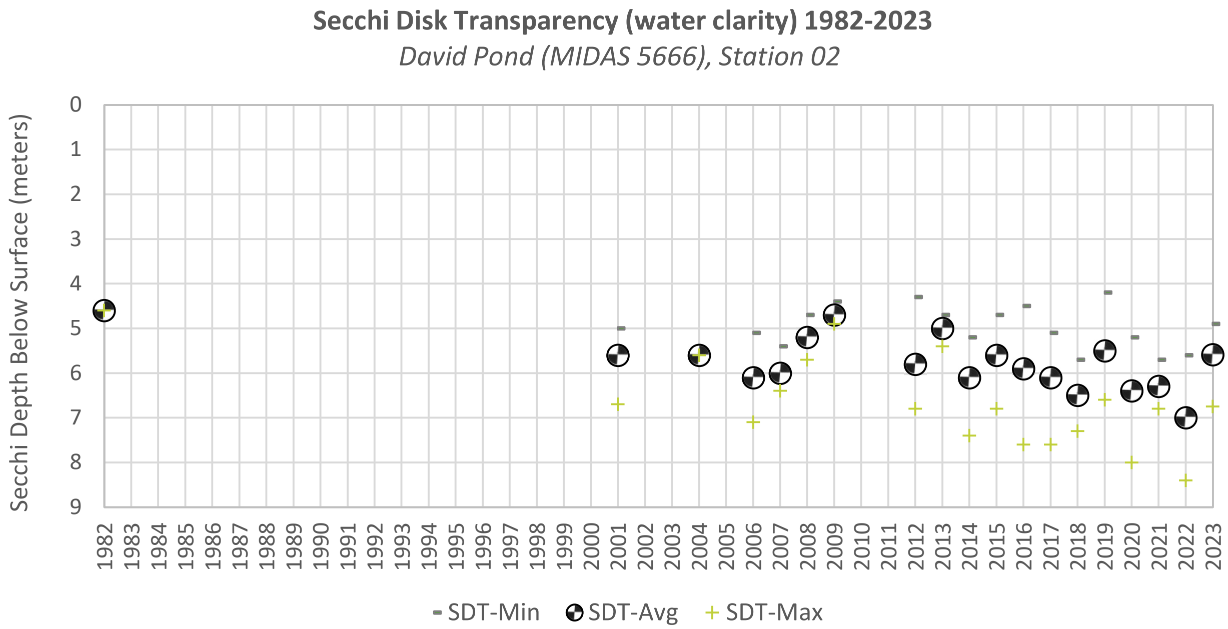


Figure 3. Historical Secchi Disk Transparency, Station 2, 1982-2023

Dissolved Oxygen and Temperature

Dissolved oxygen (DO) is a critical indicator of the health of the lake system. DO is produced through photosynthesis, consumed during respiration and decomposition, and is influenced by wind, wave action, weather events, and overall lake productivity. A good supply of oxygen is essential for fish and other aquatic species, with most fish species requiring a DO concentration of 5 mg/L or more. As lake water is warmed during the summer, deep lakes will form three distinct temperature layers. There is a warm layer at the surface (epilimnion), a thin transitional layer (metalimnion), and a deep cold layer (hypolimnion). The change in water temperature and density at the metalimnion acts as a physical barrier that prevents mixing of the upper and lower layers for several months during the warm summer months.

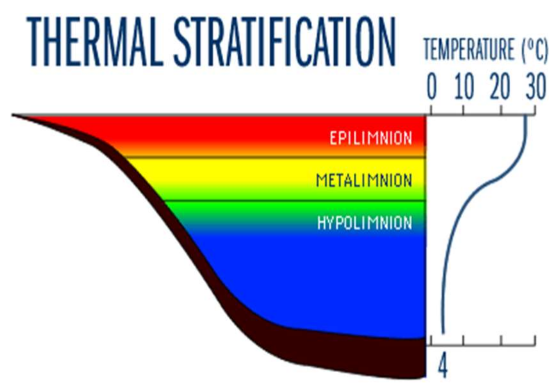


Figure 11. Thermal stratification in a deep lake. Image source: www.waterontheweb.org.

As lakes become more biologically productive in the summer, oxygen can decline as decomposition occurs in deep areas of the lake. While oxygen loss in the bottom waters of deep lakes is common in the summer months, excessive loss of oxygen may indicate a stressed and changing ecosystem. Understanding the pattern and extent of oxygen loss in deep waters is important to understanding changes between the years and throughout a single season, and is particular concerning for David Pond because it may be more vulnerable to internal phosphorus loading due to its unique sediment chemistry.[2]

In David Pond, severe oxygen loss in the hypolimnion typically occurs in July through September each year. DO <5 mg/L was documented in every profile collected in 2023 and was first encountered in waters eight (8) meters and deeper in late May, but grew to include all waters 5 meters and deeper starting in July. Severe oxygen loss (DO <2 mg/L, a.k.a. "anoxia") was first documented at a depth of 11 meters in late May, but this zone of anoxic water grew to include all waters 5 meters and deeper by August, and persisted in waters 7 meters and deeper through September and October (Figure 4).

Though oxygen loss in the deep areas of David Pond is not uncommon in recent years, reference historical data is quite limited with DO data collection starting only somewhat recently in 2013.

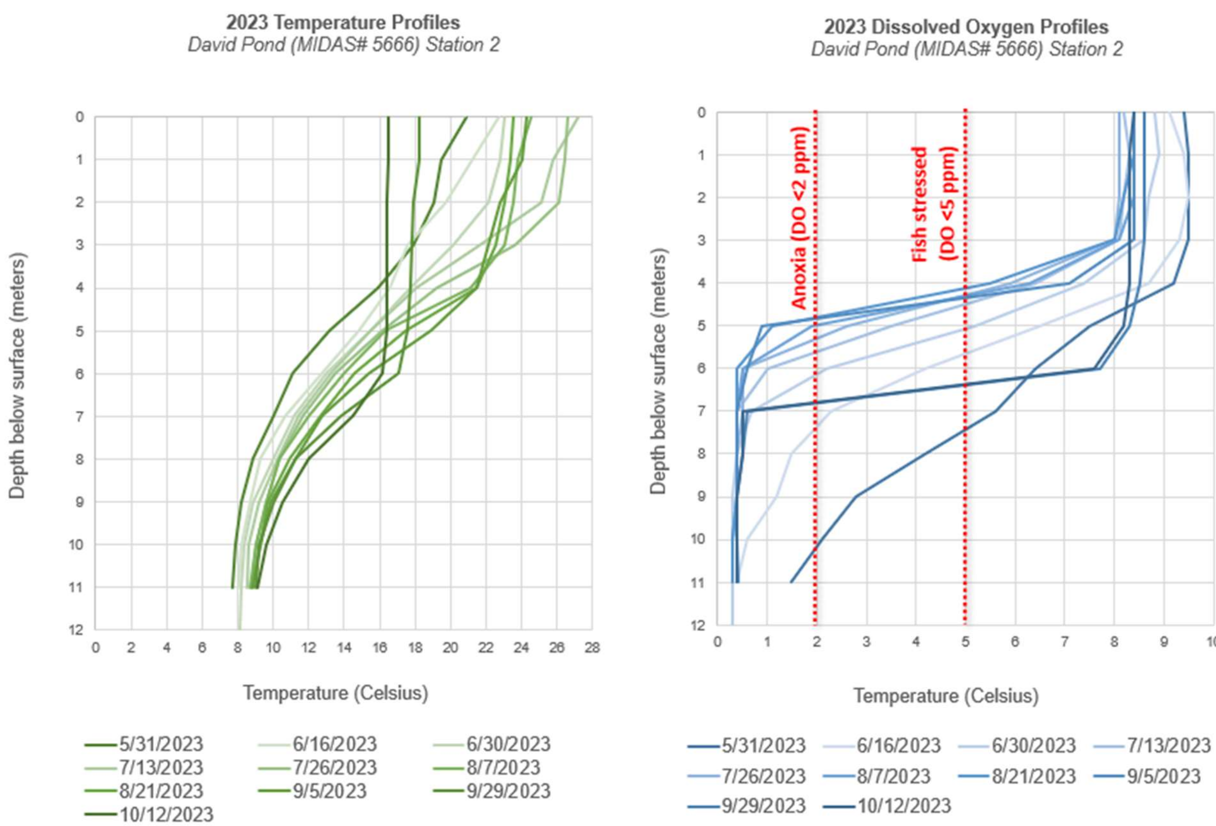


Figure 5. 2023 Dissolved Oxygen and Temperature Profiles, Station 2

[2]David Pond appears on Maine DEP's list of "Threatened Lakes" on the NPS Priority Watersheds List (https://www.maine.gov/dep/land/watershed/nps_priority_list/NPS%20Priority%20List%20-%20Lakes20.pdf) due to its sediment chemistry. Sediment results from samples collected from the bottom of David Pond suggest that the lake is more vulnerable to internal phosphorus loading, a phenomenon that can occur when deep waters become anoxic (DO loss <2 mg/L) resulting in phosphorus release from the bottom sediments exposed to anoxic waters.

David Pond supports a warm water fishery (large and smallmouth bass, and chain pickerel) due to this oxygen deficiency in the deeper, cool waters of the pond.[3]

Water surface temperatures through the 2023 monitoring season ranged from 16.5 C (61.7 F) to 27.2 C (81.0 F) with an average surface water temperature of 27.2 C (81.0 F) between May and September. Continued collection of bi-weekly DO and temperature profiles will identify trends and changes occurring in David Pond in order to better understand variations in thermal stratification and the extent and severity of the low DO and anoxic zones throughout the monitoring season.

Total Phosphorus (TP)

Total Phosphorus (ppb)	
2023 TP Average	6.8
Historical TP Average	7.4
Maine Lakes TP Average	12

Phosphorus is the nutrient that most influences the growth of algae in lakes. Because its natural occurrence in lakes is very small, phosphorus "limits" the growth of algae in lake ecosystems. Small increases in phosphorus in lake water can cause substantial increases in algal growth, hindering lake health as well as the economic, recreational, and aesthetic value of the lake. Tracking in-lake phosphorus levels over time is another way of monitoring change in lake water quality trends.

Ten (10) water samples were collected by 30 Mile staff this year and analyzed for Total Phosphorus (TP). Samples were collected monthly between May and September. Five (5) of the phosphorus samples were collected from the top layer of David Pond using an integrated core sampler and are referred to as "epilimnetic core samples". Laboratory results for epilimnetic core samples collected in 2023 ranged from 6 ppb to 8 ppb with an annual average of 6.8 ppb.

Generally speaking, in-lake phosphorus concentrations (epilimnetic samples) less than 10 ppb are good. Lakes with in-lake phosphorus concentrations of 13 ppb or more are able to sustain algal blooms, and blooms become frequent as average concentrations approach 20 ppb. Historically, the annual average in-lake phosphorus concentration in David Pond has ranged between 6 ppb (1982, 2016, 2017) and 10 ppb (2020) with a historical average annual concentration of 7.4 ppb (Figure 5). TP data for David Pond is also quite limited, with data collected during only 10 years within the 41-year monitoring record starting in 1982 (Figure 5).

[3] Maine Department of Inland Fisheries & Wildlife. Lake Survey Maps – David Pond. Accessed online: https://www.maine.gov/ifw/docs/lake-survey-maps/kennebec/david_pond.pdf.

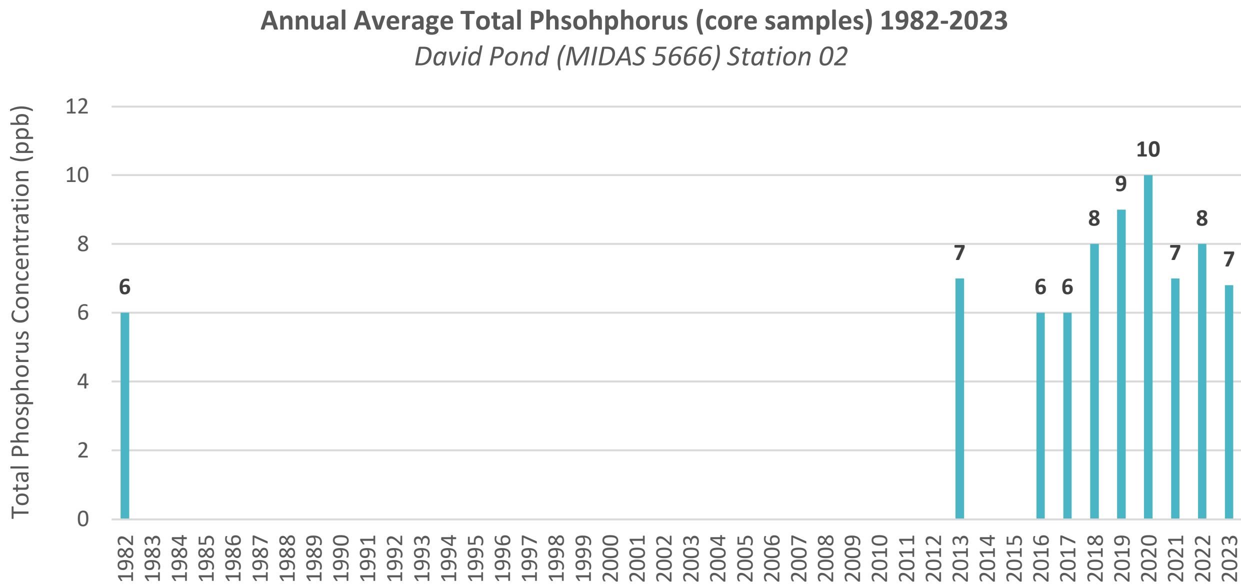


Figure 6. Annual Average Total Phosphorus data (epilimnetic core samples) collected 1982-2023, Station 2.

Five (5) TP samples were collected from the bottom of David Pond using a Kemmerer grab sampler; this type of sample is known as a "bottom grab". Bottom grabs are collected when anoxia is encountered anywhere in the dissolved oxygen profile, and help us determine if there is active phosphorus release from bottom sediments exposed to anoxic conditions. Laboratory results for bottom grab samples collected in 2023 were 15 ppb (5/31), 12 ppb (6/30), 15 ppb (7/26), 25 (8/21), and 20 (9/29) with a 2023 annual average of 18 ppb (Figure 6).

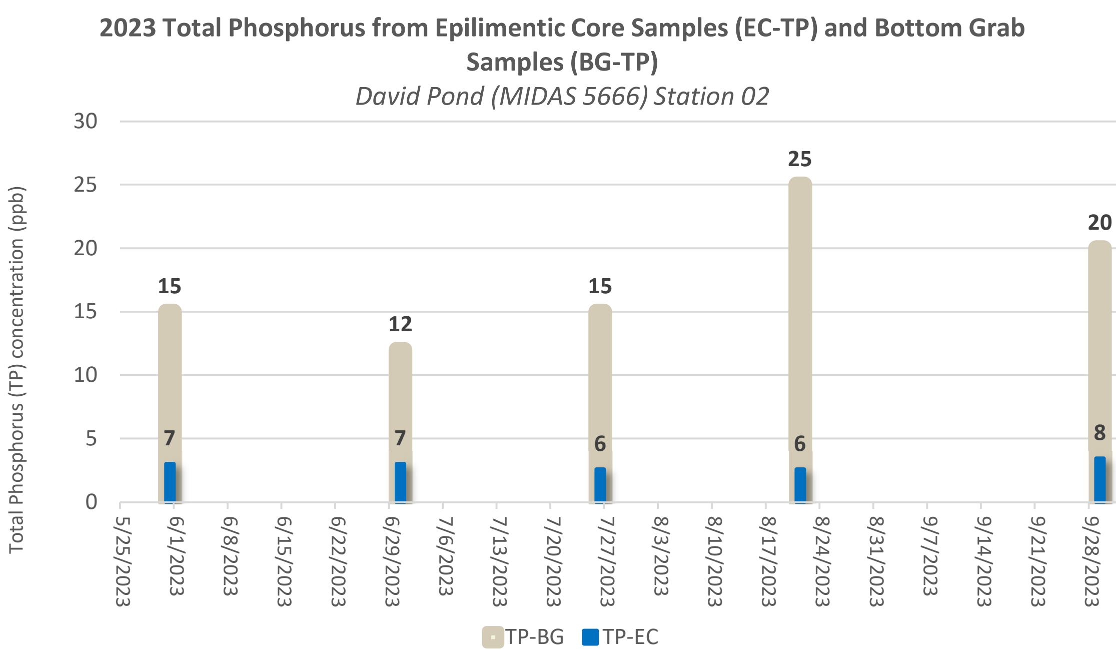


Figure 7. 2023 TP epilimnetic core sample and bottom grab sample results from David Pond.

Historically, bottom grab samples were collected during 8 years throughout the 41-year monitoring record. Average annual bottom grab TP concentrations have ranged between 13 ppb (2013) and 30 ppb (2018) with an overall historical average of 20 ppb.

Chlorophyll (Chl-a)

Chl-a (ppb)	
2023 Chl-a Average	4.6
2023 Peak Chl-a	7.0
Historical Chl-a Average	3.6
Maine Lakes Chl-a Average	5.4

Chlorophyll is found in plants (including algae) and is used to convert sunlight into energy. Measuring the concentration of Chlorophyll in lake water helps us estimate the algae population in the lake.

Chlorophyll was measured five (5) times in 2023. Results ranged from 3 ppb to 7 ppb, with a 2023 annual average of 4.6 ppb. Historical Chl-a data collected during nine (9) years between 1982-2023 has ranged from 1.0 ppb (2018) to 7 ppb (2013 and 2023) with an overall historical average of 3.6 ppb. 2023's annual average of 4.6 ppb is the second highest average out the nine (9) total years that chl-a has been analyzed in David Pond. Chl-a peaked in late June in 2023 with a result of 7 ppb – the highest chl-a concentration documented in David Pond (7 ppb also observed in 2013).

pH

pH	
2023 pH	7.1
Historical pH Average	7.0
Maine Lakes Average	6.44

pH helps determine which plant and animal species can live in the lake, and it governs biochemical processes that take place. The pH scale ranges from 0-14, with 7 being neutral. Water is increasingly acidic below 7, and increasingly alkaline above 7. A one unit change in pH represents a tenfold change in acidity or alkalinity. The pH scale is the inverse log of the hydrogen ion concentration.

pH was measured one time during the 2023 season on August 21st with a result of 7.1. Historically, pH has been analyzed during five (5) years out of the 41-year monitoring period with results ranging between 6.9 (2018) and 7.2 (2017) and a historical annual average of 7.0.

True Color

Color (PCU)	
2023 Color	17
Historical Color Average	15
Maine Lakes Color Average	21

Water color refers to the concentration of natural dissolved organic acids. This includes natural tannins and lignins dissolved in the water, often resulting in "tea" or "root beer" colored water in very colored lakes. "True Color" is measured in Platinum Cobalt Units (PCU) after all particulates (including algae cells) have been filtered out of the sample. Colored lakes (>25 PCU) can naturally have reduced transparency readings and increased phosphorus values. However, this does not mean the lakes produce more algae. The color simply reduces the transparency such that the reading is not a good measure of algal biomass. Chlorophyll-a (Chl-a) is the best indicator of algal productivity in colored lakes and should be used if possible.

One (1) sample taken on August 21st was analyzed for true color and had a result of 17 PCU. Historically, true color data has been collected during five (5) years of the 41-year monitoring period, ranging between 9 PCU (2022) and 31 PCU (2013) and a historical annual average of 15 PCU.

Conductivity

Conductivity (µMHOS/cm)	
2023 Conductivity	61
Historical Conductivity Average	53
Maine Lakes Conductivity Average	51

Conductivity measures the ability of water to carry electrical current and is directly related to the dissolved ions (charged particles) present in the water. Fishery biologists can use conductivity values to calculate fish yield estimates because conductivity will generally increase if there is an increase of pollutants entering the lake or pond. Stormwater runoff from developed areas and roadways is the most common pollutant in Maine lakes that can raise conductivity values. Conductivity is measured in micromhos per centimeter (µMHOS/cm).

One (1) sample taken on August 21st was analyzed for conductivity and had a result of 61 µMOHS/cm. Historically, conductivity has been measured during six (6) years of the 41-year monitoring period, with results ranging between 39 µMOHS/cm (1982) and 65 µMOHS/cm (2022) and a historical annual average of 53 µMHOS/cm.

Alkalinity

Alkalinity (mg/L)	
2023 Alkalinity	10
Historical Alkalinity Average	9.6
Maine Lakes Alkalinity Average	11.7

Alkalinity is also referred to as “buffering capacity.” It is a measure primarily of naturally available bicarbonate, carbonate, and hydroxide ions in the water and is measured in milligrams per liter (mg/L). Measuring alkalinity is important to determining a lake’s ability to neutralize acidic pollution from rainfall or snowmelt. Lakes with alkalinity values >20 mg/L are considered well buffered against pH changes over time. Lakes with low or zero alkalinity may have more variation in pH levels that can sometimes result in damage to aquatic life.

One (1) sample taken on August 21st was analyzed for alkalinity and had a result of 10 mg/L. Historically, alkalinity was measured during five (5) years of the 41-year monitoring period and has ranged between 8 mg/L (1982) and 10 mg/L (2017, 2022, & 2023) with a historical average of 9.6 mg/L.

Discussion

2023 was 30 Mile's eighth year of monitoring David Pond's water quality. Historical data presented in this report includes all monitoring data collected through 2022, submitted by volunteer monitors, 30 Mile staff, and other state agencies, that has undergone a thorough QA/QC process at Maine DEP. 2023 data included in this report is data collected by 30 Mile only.

Five years of consecutive data collection for any given parameter will provide the baseline condition for water quality. 10 years of consecutive data collection is needed to meet the minimum data thresholds for determining trends over time. 30 Mile's monitoring program will continue to develop a robust dataset that can help our community identify and address water quality concerns in David Pond.

Throughout the 2023 season, David Pond's water clarity remained below average, with the annual average nearly 1 meter shallower than the past 5-year average. These results and readings are likely to be a result of the unusual amount of precipitation the region received this spring and summer that brought an unprecedented amount of polluted stormwater runoff into our lakes.

Although severe anoxia in David Pond's bottom 5 to 6 meters is common since DO monitoring began in 2013, the anoxic zone at the bottom of the lake reaching a depth as shallow as 5 meters this August was the shallowest depth anoxia has ever been recorded in David Pond. This large area of anoxia persisted through August and into early September until the lake began the process of mixing in late September and October. This trend of growing anoxic area in David Pond is a concern because it's sediment chemistry indicates a greater risk of internal phosphorus loading from bottom sediments exposed to anoxic waters.

Annual average chlorophyll (chl-a) in 2023 (4.6 ppb) is the highest annual average since 2013, and tied 2013 for having the highest chl-a reading on record of 7 ppb. Average Chl-a has otherwise been around or below 3 ppb during all other years measured. It is possible that the greater amount of runoff entering the lake this spring caused reduced clarity readings and resulted in an elevated algal population in the lake this year.

It's important to continue our bi-weekly monitoring effort, to better understand these trends and the impact that long term changes in our weather can have on David Pond. Near real-time data for David Pond's clarity (Secchi depth), and dissolved oxygen and temperature profiles can be found online at https://30mileriver.org/david-pond/, along with a link to the historical dataset and depth map.

Next Steps

1. Continue bi-weekly baseline monitoring between May and October each year to monitor seasonal and annual variability across all parameters, and better document changes and trends over time.

2. Continue to deliver LakeSmart programming on David Pond, providing education to shorefront property owners about polluted stormwater runoff, phosphorus, and the effects that watershed development can have on lake water quality. To request a visit from the LakeSmart team on David Pond, contact volunteer coordinator Deb Cayer: debbiecayer@gmail.com.

3. Work with 30 Mile to review the list of priority sites identified during the 2011 watershed survey and determine next steps to address remaining priority sites.

4. If you have an erosion or runoff problem on your shorefront and are unsure how to address it, contact 30 Mile for a free site visit and recommendations: Whitney Baker, Program Director, whitney@30mileriver.org or (207) 860-4043.