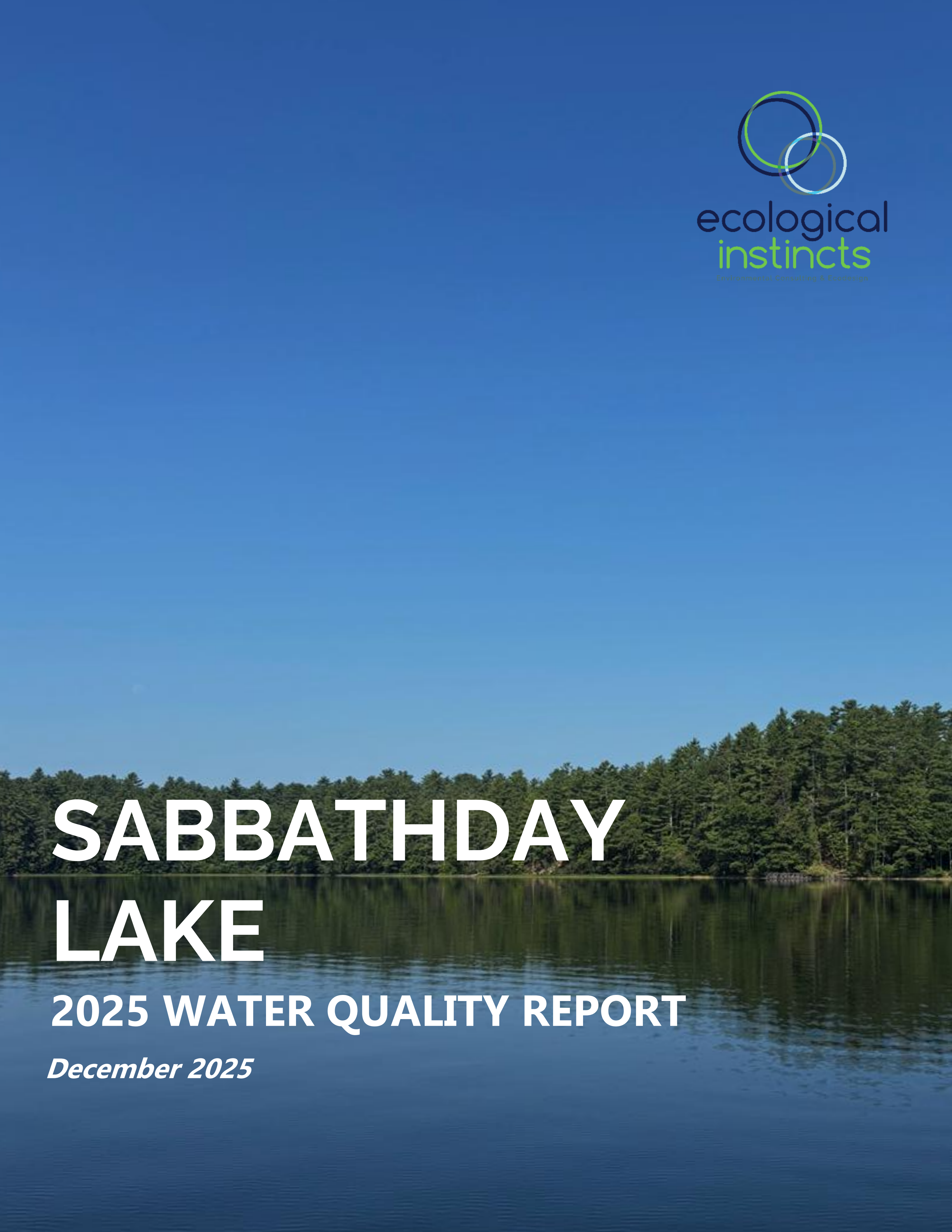

ecological instincts

SABBATHDAY LAKE

2025 WATER QUALITY REPORT

December 2025

2025 SABBATHDAY LAKE WATER QUALITY REPORT

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Special thanks *to volunteer Don Grant for providing a motorboat and good company over the course of the 2025 monitoring season.*

Cover photo: *Sabbathday Lake, July 2025. Unless otherwise noted, all photos were provided by Ecological Instincts.*

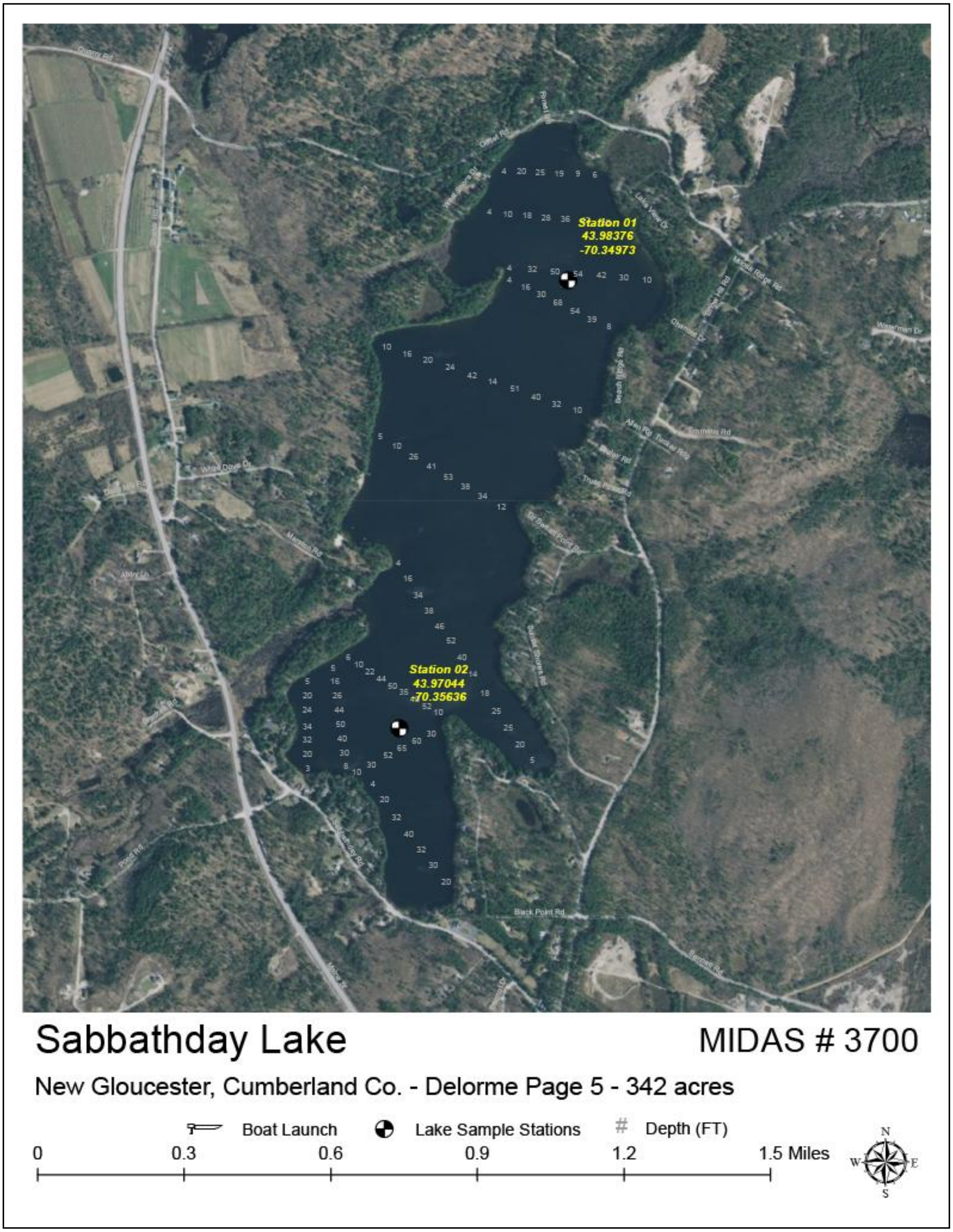

Figure 1. Sabbathday Lake bathymetric map showing deep hole sampling location (Station 1). (Source: lakesofmaine.org)

COMMONLY USED TERMS

EPILIMNION- the portion of the water column from the surface of the lake to the upper part of the thermocline.

CHLOROPHYLL A (CHL-A)- the green pigment found in all plants, including algae. Measuring it allows us to estimate the amount of algae present in the water column.

DISSOLVED OXYGEN (DO)- the concentration of oxygen that is dissolved in water. The presence of oxygen is essential to the survival of many organisms that live in aquatic ecosystems.

HYPOLIMNION- the dense bottom layer of water in a thermally stratified lake. The hypolimnion typically contains the coldest water in the summer when the lake is stratified and can be subject to oxygen depletion because it is cut-off from wind-driven surface mixing.

METALIMNION- the seasonal, thermally stratified layer of a lake characterized by a rapid change in temperature (and often oxygen levels) with depth that effectively separates the waters of the epilimnion from the hypolimnion during summer stratification.

EPILIMNION- the seasonal, thermally stratified top layer of a lake above the metalimnion.

SECCHI DISK TRANSPARENCY (SDT)- represents the lake's water clarity, measured by lowering a black and white Secchi disk from a boat at the surface down into the water column until it is no longer visible.

THERMOCLINE- the thin but distinct transitional layer in a lake located between the warmer water at the surface and the cool deeper water below.

TOTAL PHOSPHORUS (TP)- the concentration of phosphorus found in the water, including organic and inorganic forms. TP is one of the major nutrients needed for plant growth.

TROPHIC STATE- A term used to describe how biologically productive a lake is, determined by various water quality parameters such as water clarity, total phosphorus, and chlorophyll a.

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BACKGROUND & PURPOSE

Photo Credit: Ecological Instincts, 2025

LAKE & WATERSHED FACTS

Watershed Towns:	**New Gloucester, Raymond & Poland, ME**
Watershed Area:	**5.3 mi^2**
Surface Area:	**331 acres**
Max Depth:	**68 ft (21 m)**
Mean Depth:	**28 ft (8 m)**
Flushing Rate:	**0.88 flushes/yr**
Lake Elevation:	**299 ft**
Avg. Clarity:	**6.8 m**

Sabbathday Lake is a 331-acre lake located in the Town of New Gloucester, Maine. The lake is located in the upper part of the larger Royal River watershed and has a direct watershed area of 5.3 square miles. It has a maximum depth of 68 feet (21 m), an average depth of 28 ft (8 m), and a flushing rate of 0.88 times per year.[1] Water flows into Sabbathday Lake from Notched Pond through Westcott Brook, and Shaker Bog, as well as from Mosquito Brook which flows into Westcott Brook in the southwest portion of the watershed. Water leaves Sabbathday Lake through the outlet at the lake's north end and flows into the Royal River. The lake is widely used for recreation including swimming, boating, and fishing, and also provides valuable habitat for fish, birds, and other wildlife. The lake supports both a coldwater and warmwater fishery and has been stocked with brown trout and brook trout by Maine Inland Fisheries and Wildlife since 1989.

Sabbathday Lake is listed on the Maine DEP's Nonpoint Source Priority Watersheds list as "Sensitive" to NPS pollution (MDEP, 2023), and on the DEP list of Lakes Most At Risk From New Development under Chapter 502 of the Maine Stormwater Management Law.

Water quality data was first collected in Sabbathday Lake in 1975, and collected more regularly beginning in 1981. Secchi disk transparency (SDT) readings have been collected most consistently, with only two years with no SDT measurements (1984 and 1985) between 1981 and 2025. Total phosphorus (TP) samples have been collected every year since 1990, and chlorophyll a (Chl-a) has been measured every year since 1996. Because of this, a robust data set is available for Sabbathday Lake, allowing for the analysis of long-term water quality trends. Maintaining this dataset is essential to document changes in water quality in Sabbathday Lake over time and identify potential water quality threats. Based on historical water clarity, TP, and chlorophyll-a (Chl-a) data, water quality in

[1] LakesofMaine, Sabbathday Lake, Sampling Station 1. Accessed online at: https://www.lakesofmaine.org/data/2018_Lake_Reports/3700_1.html

Sabbathday Lake is considered above average with intermediate levels of TP, Chl-a, and water clarity (classified as a mesotrophic lake by the Maine DEP).

METHODS

Ecological Instincts collected water quality data at Station 1 (deep hole) on Sabbathday Lake over the course of three sampling events in 2025 (July 10, August 13, and September 11). Sampling was conducted in accordance with standard methods and procedures for lake monitoring established by the Maine Department of Environmental Protection (Maine DEP), the U.S. Environmental Protection Agency (USEPA), and the Lake Stewards of Maine (LSM). All water samples were analyzed at the Health and Environmental Testing Lab (HETL) in Augusta.

Project Scientist Katie Goodwin measuring dissolved oxygen at Sabbathday Lake.

An integrated epilimnetic core (representing lake water from the surface to the upper part of the thermocline) was collected for each sampling event. Epilimnetic core depth varied between 5 and 6 m over the course of the season due to changes in thermal stratification during this time period. Water quality parameters measured include key trophic state indicators (SDT, TP, Chl-a), as well as color, alkalinity, pH, dissolved oxygen (DO), and water temperature profiles. TP was measured both by collection of epilimnetic cores at all three sampling events, and by collecting a bottom grab sample in September to help characterize internal phosphorus loading in the lake. Phytoplankton samples were collected from an epilimnetic core at each sampling event, preserved in the field, and enumerated by Dr. Ken Wagner of Water Resource Services.

RESULTS

WEATHER & CLIMATE CHANGE

Variation in weather patterns from year to year is an important driver of annual variability in lake water quality. Higher (air and water) temperatures lead to earlier ice-out and later ice-in, resulting in longer and stronger stratification periods, which leads to increased algal growth, greater oxygen demand due to decomposition on the lake bottom, and lower oxygen near the lake bottom. Surface water temperatures in northern New England increased 1.4 °F per decade from 1984-2014, which is faster than the worldwide average, with Maine lakes warming on average by nearly 5.5 °F during this time (MCC, 2020).

Increased amounts of precipitation also increase the amount of runoff that the lake receives from its watershed, meaning that drier years may result in lower phosphorus levels and better water quality, and years with more precipitation may result in higher phosphorus levels and poorer water quality.

The highest precipitation in the region over the past 10 years occurred in 2023, with 32 inches of rain during the summer (May-September). The lowest summer precipitation was in 2016 with only 12 inches of rain. **In 2025, the total summer precipitation was relatively low with a total of 16.1 inches, although almost half the total summer precipitation occurred in May.** Precipitation levels were extremely low in August, with just 0.38 inches of rain. Despite fluctuations from year to year, an overall trend of bigger and more frequent storms is expected due to climate change and could lead to an increase in the amount of phosphorus getting to the lake via increased erosion and polluted runoff.

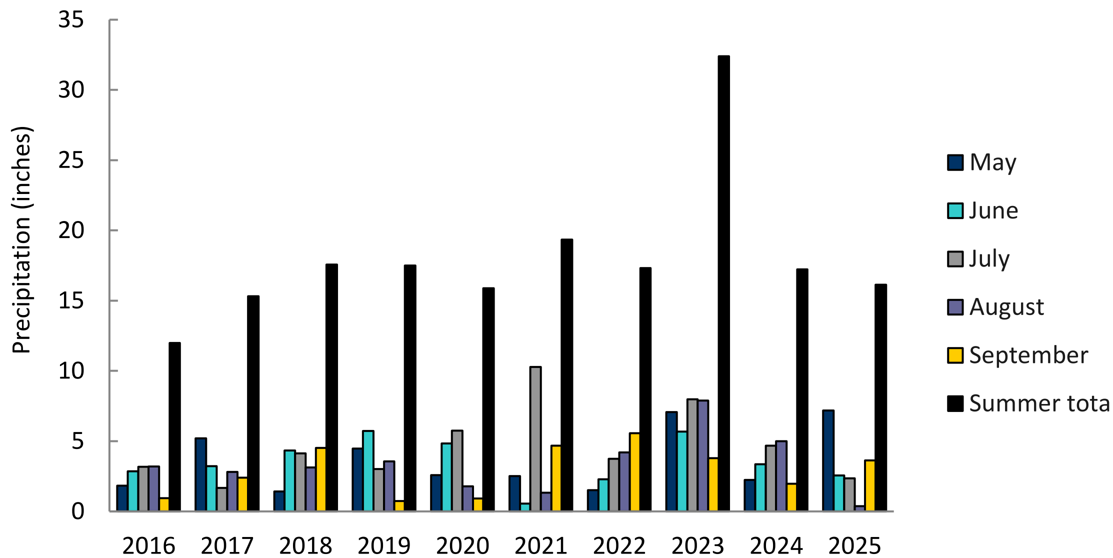


Figure 2. Total and monthly precipitation for Sabbathday Lake from May-September, 2016-2025. (Data source: NOAA NCDC, station GHCND: US1MECM0003 - New Gloucester 3.0, SE, ME, US (2023) and station GHCND:USC00173295– Gray, ME, US).

TROPHIC STATE INDICATORS

Trophic state indicators (SDT, Chl-a, and TP) and are key parameters for measuring how productive a lake is and can be used to calculate a Trophic State Index (TSI) which can be compared to other lakes across the state. In Maine lakes, TSI ranges from 8-136 with a mean of 45. The last TSI index calculated for Sabbathday Lake was calculated in 2016 by Maine DEP with a value of 29.9. Lakes with TSI values <30.68 are categorized as unproductive, so Sabbathday Lake is on the high end of this range, moving toward the moderately productive category (TSI 30.68 – 60.93). Ongoing data collection will allow this value to be updated.

Water Clarity

Measuring water clarity (a.k.a. transparency) is one of the most useful ways to show whether a lake is changing from year to year. Changes in transparency may be due to increased or decreased algal growth, or the amount of dissolved or particulate materials in a lake, resulting from human disturbance or other impacts to the lake watershed area. Factors that affect transparency include algae, water color, and sediment. Since algal density is usually the most common factor affecting transparency in Maine lakes, transparency is an indirect measure of algal abundance. Water clarity is measured using a Secchi disk, obtained by lowering a black and white disk into the water until it is no longer visible.

Table 1. Average annual water clarity for Sabbathday Lake at Station 1 (1975-2025).

Water Clarity (m)			
Years	Annual SDT Mean	Min	Max
2025 Sabbathday Lake	**7.9**	**7.0**	**8.5**
Historical Average (1975-2025)	6.7	5.5	7.9
10-Year Average (2016-2025)	7.2	5.8	7.9
Avg. Maine Lakes	5.5	<0.5	21.3

Water clarity in Maine lakes ranges from under <0.5 m to 21.3 m with a statewide average of 5.5 m (LSM and MDEP, 2025). Transparency readings of 2 m or less generally indicate an algal bloom. **The annual average for Sabbathday Lake in 2025 was 7.9 m, the highest annual average SDT on record** (Table 1). Transparency increased throughout the sampling season in 2025, likely due to drought conditions experienced in late summer. Since rain washes phosphorus from the surrounding watershed into the lake, there may not have been significant external loading during this period. The lowest annual average water clarity measured over the historical sampling period (since 1975) is 5.5 m (1989). Historical average water clarity for Sabbathday Lake is 6.7 m.[2] Long-term annual average water clarity has remained steady (Figure 3 & 4) or improved slightly, with an average SDT over the first 10 years of continuous sampling (1986-1995) of 6.5 m, vs. an average SDT over the last 10 years (2016-

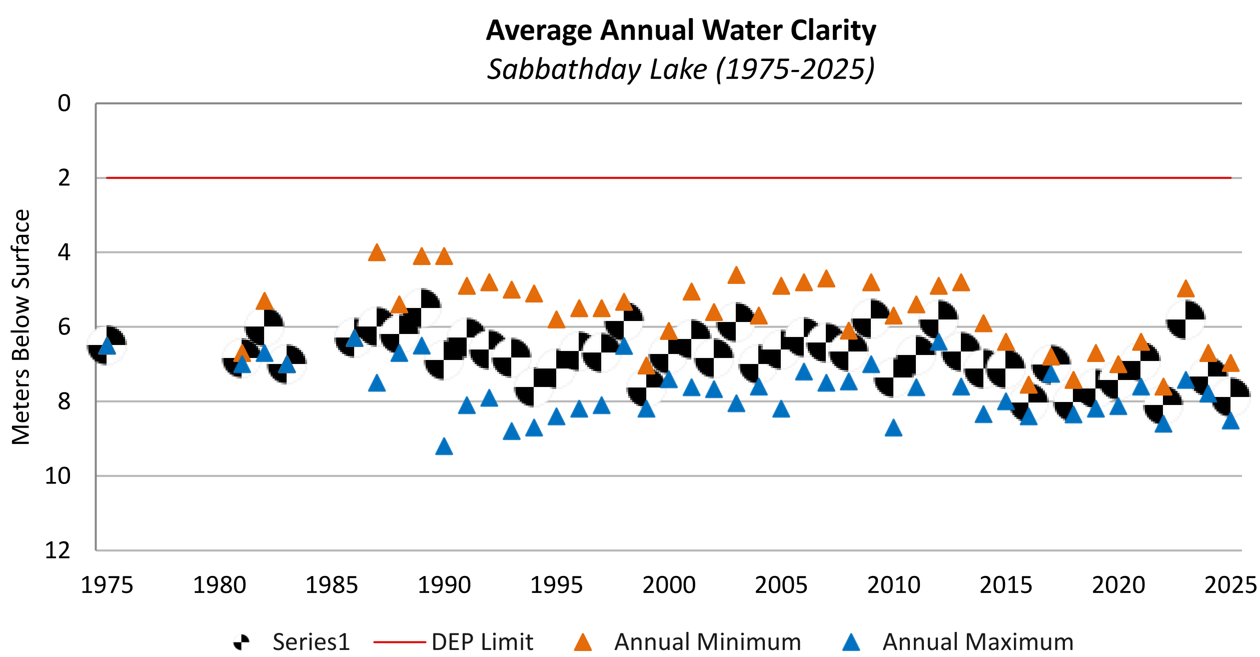


Figure 3. Average annual water clarity for Sabbathday Lake, Station 1 (1975-2025). Data from MDEP, VLMP/LSM, FBE, and Ecological Instincts.

[2] Annual averages for SDT from most recent available data on Lakes of Maine through Maine DEP, and includes data collected by Ecological Instincts, FBE, Maine DEP, and LSM volunteers. Annual averages from 2022 and earlier have been updated to include data from all sources, and therefore, may differ from averages reported in past reports that only included data collected by Ecological Instincts.

2025) of 7.2 m. While there significant variability between years, many recent years, especially 2025, have had particularly clear water quality.

Total Phosphorus

Total phosphorus (TP) is the concentration of phosphorus found in the water, including organic and inorganic forms. TP is one of the major nutrients for plant growth. It is generally present in small amounts and limits plant growth in freshwater ecosystems. As phosphorus increases, the amount of algae generally increases. Humans can add phosphorus to a lake through stormwater runoff, lawn, or garden fertilizers, and leaky or poorly maintained septic tanks.

Single value epilimnetic TP readings in Sabbathday Lake have ranged from 3 ppb (1995, 2018, 2025) to 15 ppb (2000). In 2025, TP in Sabbathday Lake ranged from 3 to 5 ppb. Average TP in 2025 was 4 ppb, the same as the 2018 annual average and the lowest on record. Average TP over the past 10 years is 5.3 ppb, slightly lower than the average over the historical sampling period (6.3 ppb), indicating an overall decrease in phosphorus in Sabbathday Lake. Trend analyses available in the Lakes of Maine Water Quality Report for Sabbathday Lake show that epilimnetic TP has decreased significantly over the last 30 years of data (1993-2022). Statewide, TP ranges from 1 - 426 ppb with an average of 11.1 ppb. **Sabbathday Lake has low levels of phosphorus compared to lakes statewide, with especially low levels of TP in 2025** (Table 2, Figure 4). While the low TP concentrations and improved water quality readings are impacted by annual weather conditions, Sabbathday Lake water quality seems to be stable or, in the case of TP shows an improving trend over the long-term.

Table 2. Average Annual TP in the epilimnion for Sabbathday Lake, Station 1 (1982-2025).

Total Phosphorus (ppb)			
Years	Annual TP		
	Mean	Min	Max
2025 Sabbathday Lake	**4.0**	**3.0**	**5.0**
Historical Average (1982-2025)	6.3	4.0	8.2
10-Year Average (2016-2025)	5.3	4.0	7.7
Avg. Maine Lakes	11.1	1	426

Bottom grab samples have been collected in Sabbathday Lake since 1982, with a total of 20 years of data between 1982-2025. There was a gap in data collection from 2012 – 2023, with bottom grab sampling resuming in 2024 and 2025. Bottom grab TP readings have ranged from 6 ppb (1995) to 22 ppb (1996), with an average of 12 ppb. TP at the bottom of the lake is generally higher than in the epilimnion, indicating that some internal loading is occurring during periods of anoxia in the summer. In 2025, TP at the bottom of the lake was 19 ppb, the same as the previous year and the second highest on record. Continued collection of bottom grab TP data will help to develop an understanding of the extent of internal loading in relation to dissolved oxygen at the lake bottom. Collecting epilimnetic core or surface grab TP samples after destratification later in the fall could reveal whether TP released from the sediments is causing an overall TP increase in the fall as it is mixed into the water column.

Chlorophyll a

Chlorophyll a (Chl-a) is the third trophic state indicator, and measures the green pigment found in all plants, including microscopic plants such as algae. It is used as an estimate of algal biomass; higher Chl-a equates to greater amount of algae in the lake. Chl-a in Sabbathday Lake was measured by collecting an "integrated core sample" from the epilimnion of the lake, representing the water column from the surface of the lake to the bottom of the epilimnion.

Table 3. Average Annual Chl-a monitoring results for Sabbathday Lake, Station 1 (1975-2025).

Chlorophyll a (ppb)			
Years	Annual Chl-a		
	Mean	Min	Max
2025 Sabbathday Lake	**1.4**	**<1.0**	**2.3**
Historical Average (1975-2025)	3.7	1.4	8.7
10-Year Average (2016-2025)	3.2	1.4	8.7
Avg. Maine Lakes	5.4	0.3	182

Chl-a in 2025 ranged from below the threshold for detection by the lab in August and September (<1.0 ppb) to 2.3 ppb in July. **Average Chl-a in 2025 was the lowest on record with an average of 1.4 ppb over the sampling season.** The highest annual average Chl-a in Sabbathday Lake was observed in 2023, at 12 ppb. Statewide, Chl-a ranges from 0.3 - 182 ppb with an average of 5.4 ppb. The 10-year average for Sabbathday Lake (3.2 ppb) is well below the state average of 5.4 ppb (Table 3). With the exception of 2023, concentrations of Chl-a in Sabbathday Lake are lower than the statewide average and have remained relatively stable over

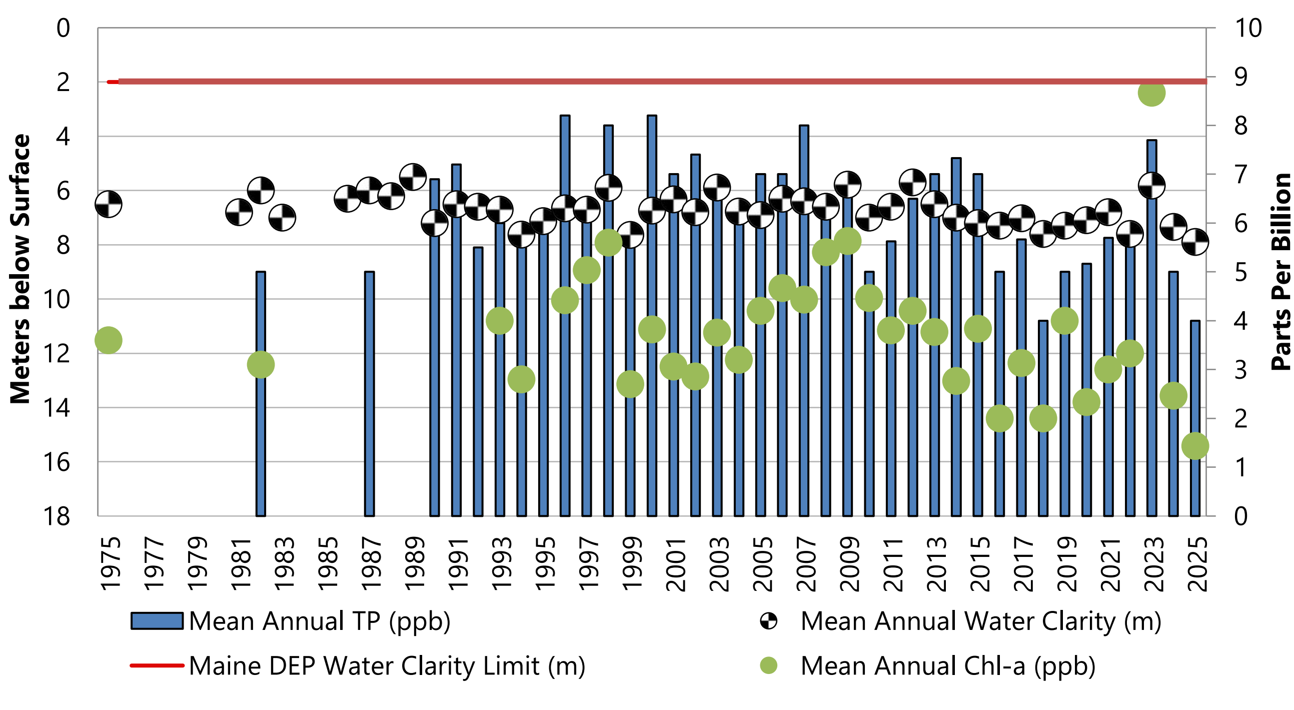


Figure 4. Average annual water quality data for trophic state indicators (water clarity, total phosphorus (TP), and Chlorophyll-a (Chl-a) for Sabbathday Lake, Station 1.

the sampling period (Table 3 & Figure 4).

DISSOLVED OXYGEN & TEMPERATURE

Sabbathday Lake's cold, deep water provides habitat for coldwater fish including brown trout and brook trout, along with warmwater fish such as largemouth bass, smallmouth bass, white sucker, chain pickerel, and black crappie. Coldwater fish begin to experience physiological stress at around 5 parts per million (ppm) of dissolved oxygen (DO), although tolerance for low oxygen conditions is species-specific. If DO drops below 2 ppm, it can impact fish survival and even cause fish kills if there is no oxygenated habitat nearby for fish to move to. Coldwater fish generally prefer water that is less than 18°C (64°F) but can tolerate temperatures up to 24°C (75°F).

In the summer, the sun warms the surface water, forcing coldwater fish to retreat to deeper, cooler, and more oxygenated water. In lakes with elevated phosphorus levels due to inputs from the watershed, cycles of de-oxygenation can form in deep water when the lake is stratified in the summer, reducing the amount of coldwater habitat available to fish. Decreased DO levels can also cause internal release of phosphorus from the sediments, contributing to elevated TP levels and increasing the likelihood of nuisance algae blooms. Sabbathday Lake has a history of DO depletion below 8 m developing annually in late summer.

Dissolved Oxygen

The 2025 DO profiles in Sabbathday Lake indicate that the lake is well oxygenated through the epilimnion (0-4 m), but that dissolved oxygen levels began to drop below 8 m in the hypolimnion (bottom layer of cold water) (Figure 5). The dissolved oxygen peak is in the metalimnion (transition area between the warm surface water and cold deep waters. The metalimnetic maximum or "oxygen bubble" could affected by a variety of factors including an increase in oxygen solubility in colder water but typically indicates areas where the algae are most productive. As algae photosynthesize carbon dioxide is taken up and oxygen released. Lakes with a sharp deep thermocline like Sabbathday can also have an availability of nutrients at this depth that are optimal for algae while still having enough light for photosynthesis.

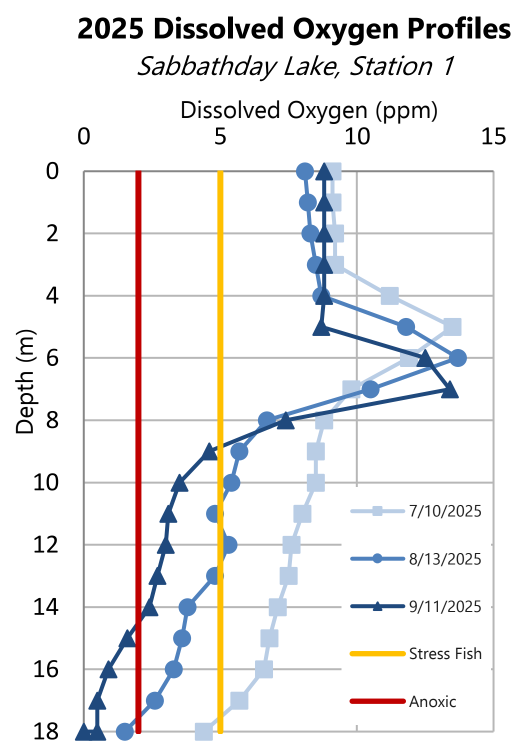


Figure 5. 2025 dissolved oxygen profiles for Sabbathday Lake, Station 1.

DO was 2 ppm or less (upper threshold for anoxia) at the bottom of the hypolimnion in August and September. In July, DO dropped to a low of 4.4 ppm at 18 m. In August and September, DO at the bottom of the lake dropped to 1.5 and 0.5 ppm, respectively. Low oxygen at the bottom of the lake can result in the release of phosphorus from bottom sediments. Collection of phosphorus grab samples (bottom grab) could help determine the influence of anoxia on internal phosphorus loading in Sabbathday Lake. Since 2011, two phosphorus bottom grab samples from Sabbathday Lake have been collected. Both samples were collected in September and measured 19 ppb, which for 2025 is nearly five times the concentration found in the epilimnion. Minimum anoxic depth (MAD) in Sabbathday Lake is highly variable and to date has shown no significant trend (refer to 2022 report for trends analysis).

Temperature

The 2025 Sabbathday Lake temperature profiles show strong stratification from top to bottom, with warmer temperatures at the surface (between 0 - 4 m) and a steady decrease in temperature through the metalimnion (4 - 8 m), with the coldest water at the bottom (8 - 18 m) (Figure 6). The surface of the lake was warmest in August (27.6°C), and coldest in September (21.3°C). Habitat for coldwater fish may have been limited during August and September 2025, since DO levels fell below 5 ppm at 11 m and 9 m, respectively, meaning that fish likely needed to move to shallower water with higher concentrations of dissolved oxygen. In August, when low DO was occurring in deeper areas and temperatures were greater than 24°C (threshold for coldwater fish stress) at the surface, coldwater fish may have retreated to depths between 6 and 10 m, where water temperature was <18°C (preferred temperature for coldwater fish) but DO was >5 ppm.

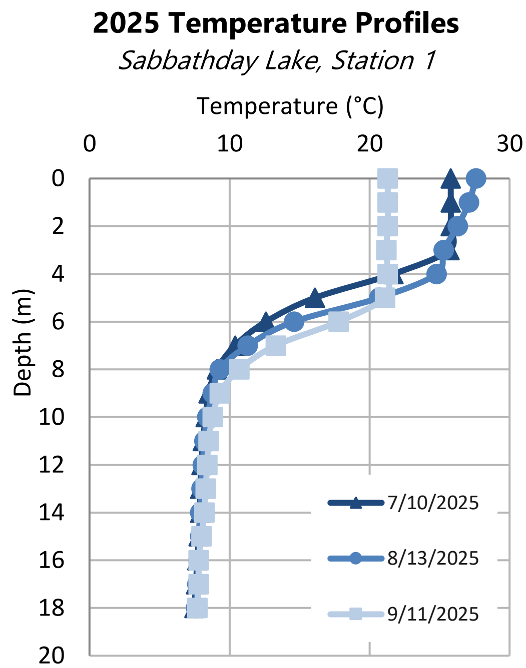


Figure 6. 2025 temperature profiles for Sabbathday Lake, Station 1.

CHEMICAL PARAMETERS

Color

Color is the influence of suspended and dissolved particles in the water as measured by Platinum Cobalt Units (PCU). A variety of sources contribute to the types and amount of suspended material in lake water, including weathered geologic material, vegetation cover, land use activity, and rainfall.

Table 4. Average annual color for Sabbathday Lake, Station 1 (1982-2025).

True Color (PCU)			
Years	Annual Color		
	Mean	Min	Max
2025 Sabbathday Lake	**11.0**	**9.0**	**13.0**
Historical Average (2004, 2012-2025)	11.8	7.0	22.7
10-Year Average (2016-2025)	11.5	7.0	22.7
Avg. Maine Lakes	20.7	0	197

Colored lakes (>25 PCU) can have reduced transparency readings and increased TP values. Color has been measured using two methods in Sabbathday Lake, true color and apparent color. Apparent color, used from 1982-2011, measures the color of the water as it is collected including whatever particulates are present in the water. True color, used for one sample in 2004 and from 2012-2025, measures color after all particulates, including algae cells, have been filtered out. In 2025, true color ranged from 9 PCU (September) to 13 PCU (July) with an average of 11 PCU. Historically, annual average true color has ranged from 7 PCU (2016) to 23 PCU (2023). True color in 2025 was below the historical average of 11.8 PCU and well below the average for Maine lakes (Table 4). **Sabbathday Lake is considered a non-colored lake and true color in 2025 was slightly lower than average** (11 PCU compared to 11.8 PCU). Low color lakes typically have good water clarity compared to more highly colored lakes.

Alkalinity

Alkalinity is a measure of the buffering capacity of a lake, or the capacity to neutralize acids. It is a measure of naturally available bicarbonate, carbonate, and hydroxide ions in the water, which is largely determined by the geology of soils and rocks surrounding the lake. Alkalinity is important to aquatic life because it buffers against changes in pH that could have drastic effects on animals and plants.

In 2025, alkalinity was 11 ppm in July and 12 ppm in August, with an average of 11.5 ppm.[3] **This is similar to both the historical average (11 ppm), and the 10-year average (11.8 ppm)** (Table 5). Average annual alkalinity in Sabbathday Lake is just below the statewide average of 11.7 ppm. Lakes with total alkalinity values >20 ppm, are considered well buffered against changes in pH, whereas lakes like Sabbathday Lake, with alkalinity between 10 and 20 ppm are more sensitive to changing pH.

Table 5. Average annual alkalinity for Sabbathday Lake, Station 1 (1982-2025)

Alkalinity (ppm)			
Years	**Annual Alkalinity**		
	Mean	Min	Max
2025 Sabbathday Lake	**11.5**	**11.0**	**12.0**
Historical Average (1982-2025)	11.0	9.0	13.7
10-Year Average (2016-2025)	11.8	11.3	12.3
Avg. Maine Lakes	11.7	-1.5	190

pH

pH is the standard measure of the acidity or alkalinity of a solution on a scale of 0-14. Most aquatic species require a pH between 6.5 and 8. As the pH of a lake declines, particularly below 6, the reproductive capacity of fish populations can be greatly impacted as the availability of nutrients and metals changes. pH is influenced by bedrock, acid rain deposition, wastewater discharge, and natural carbon dioxide fluctuations.

Table 6. Average annual pH for Sabbathday Lake, Station 1 (1982-2025).

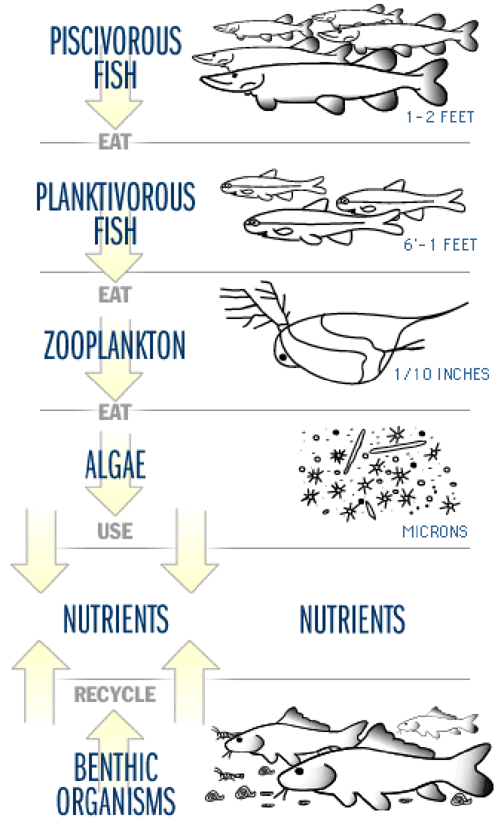
pH			
Years	**Annual pH**		
	Mean	Min	Max
2025 Sabbathday Lake	**6.9**	**6.6**	**7.4**
Historical Average (1982-2025)	7.0	6.6	7.5
10-Year Average (2016-2025)	6.9	6.6	7.4
Avg. Maine Lakes	6.8	4.2	9.6

[3] Alkalinity was not measured in Sabbathday Lake in September 2025 due to insufficient quantity of water in the sample bottle.

pH in Sabbathday Lake has ranged from 6.6 (1982, 2022) to 7.5 (2013). In 2025, average pH was 6.9, with a maximum pH of 7.4 (September) and a minimum pH of 6.6 (August). **The pH in Sabbathday Lake in 2025 was slightly below the historical average and the 10-year average for the lake** (Table 6). A statistical analysis of pH at Sabbathday Lake in 2022 showed a decrease in pH between 2012-2018 based on seven years of data. This analysis should be expanded to include more recent data, which seems to be in line with this slightly decreasing trend since 2012.

PLANKTON COMMUNITY

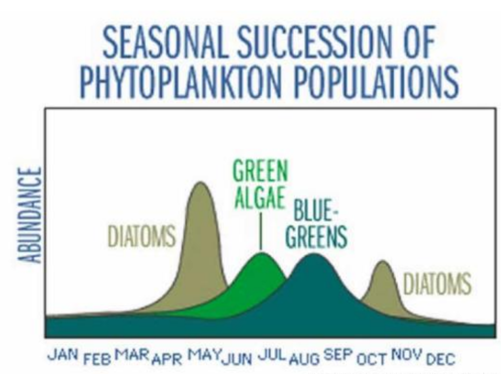
Tiny aquatic plants (algae or phytoplankton) and animals (zooplankton) are the primary source of food and energy in a lake food web and play a key role in lake ecosystems (right). Because plankton float in the water column, they influence the transparency of the water throughout the season and from year to year as these communities undergo both seasonal and annual growth cycles. Secchi disk transparency is often at its lowest in the spring and fall when lakes undergo "turn over." This bi-annual mixing suspends nutrients and sediment in the water column for a period of time, stimulating the growth of certain algae. For example, silica from sediment that is suspended in the water column during spring and fall mixing fuels diatom blooms, often resulting in slight decreases in transparency during this time. Once the lake becomes thermally stratified in the summer, other types of algae will dominate the water column (right) depending on weather, wind, nutrient inputs, and water temperature, among other factors.



A typical lake food web.
(Source: www.waterontheweb.org)

Phytoplankton

Phytoplankton are microscopic plants, also known as algae, that float in the water column of a lake. Phytoplankton are the primary source of energy in most lake systems because they photosynthesize- using the sun's energy to turn carbon dioxide and water into food and energy, providing the primary food source for organisms higher in the food web such as zooplankton and small fish. Phytoplankton are sensitive to changes in lake ecosystems. The effects of environmental and watershed impacts can often be detected in changes in the plankton community species composition, abundance, and biomass.



Example of seasonal succession of phytoplankton communities within a lake. (Source: www.waterontheweb.org)

Phytoplankton community results for 2025 are summarized below and Appendix A indicating the total number of individuals and biomass by class. Throughout the summer, golden algae dominated the water column by both cell density and biomass. Of the golden algae, there were high levels of *Chrysosphaerella* (especially in July) with lower levels of *Dinobryon*, and *Synura*. The only cyanobacteria present was *Chroococcus*, which is not known to be bloom-forming nor a producer of cyanotoxins. Small quantities of diatoms were also present throughout the summer. **The overall phytoplankton biomass for 2025 was low, and not indicative of any current water quality issues.** Phytoplankton observed in Sabbathday Lake in 2025 primarily consisted of harmless non-bloom forming phytoplankton and at levels indicative of good water quality overall in the lake.

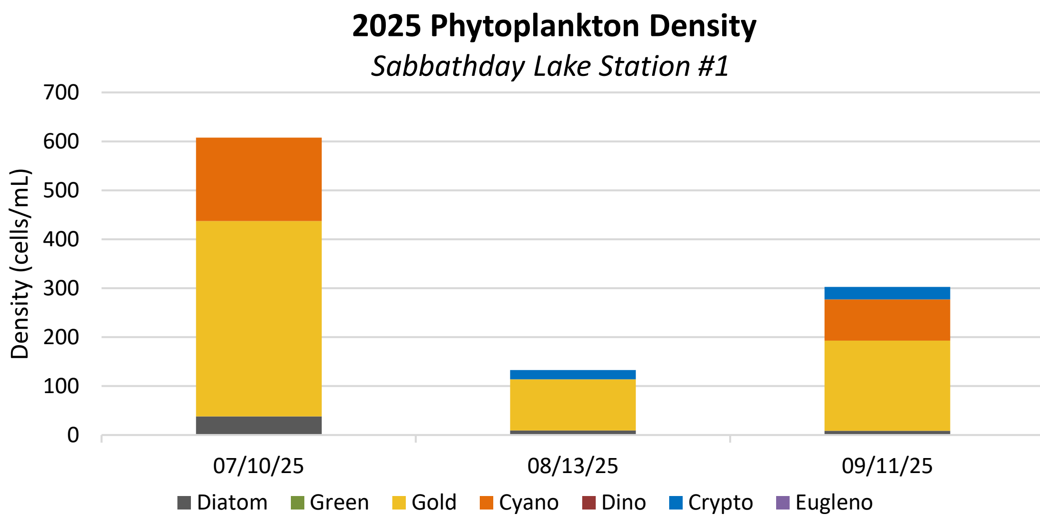


Figure 7. Phytoplankton density for Sabbathday Lake, July-September 2025.

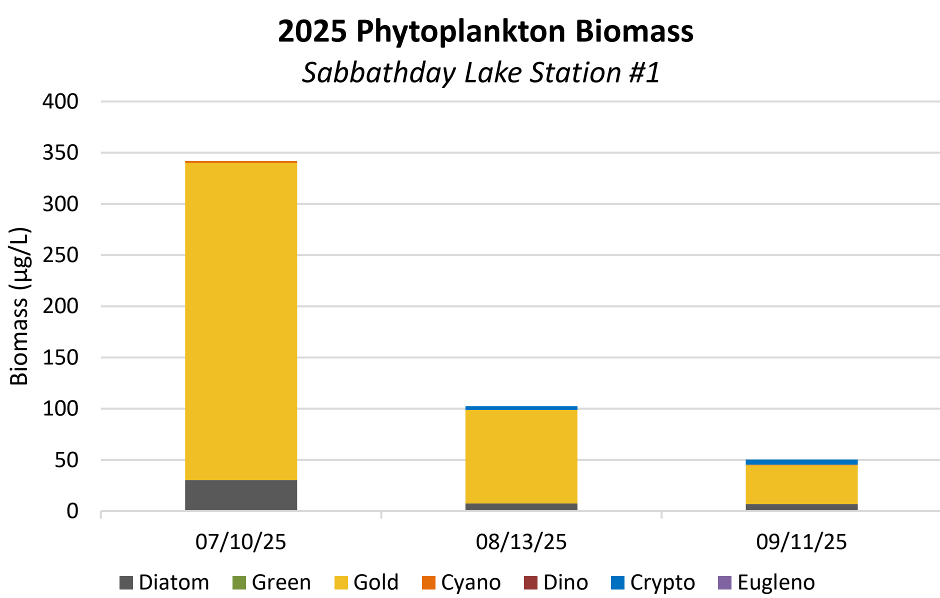


Figure 8. Phytoplankton biomass for Sabbathday Lake, July-September 2025.

Gloeotrichia echinulata or "Gloeo" is a genus of planktonic freshwater cyanobacteria that forms tiny spheres that are visible to the naked eye floating in the water column. *Gloeo* grows at the sediment-water interface and then rises through the water column to the surface waters where it completes its life cycle, dies, and sinks back down to the bottom of the lake where it will stay through the winter months until conditions are again suitable for growth (King & Laliberte, 2005). The presence of *Gloeo* has been documented in Sabbathday Lake in the past and in 2025 visual assessments indicated that *Gloeo* was present at low density in August and September. *Gloeo* was not observed in phytoplankton samples.[4]

SUMMARY

Sabbathday Lake has above average water quality compared to the average for Maine Lakes (Table 7). 2025 monitoring results for some parameters indicate that water quality in 2025 was slightly better than what has been observed in recent years, with the following observations:

- Summer (May-September) precipitation totals were low compared to rainfall records from the past 10 years, especially in late summer, resulting in less runoff into the lake in 2025.
- Average annual water clarity was the highest (clearest) since sampling began in 1982.
- Total phosphorus concentrations were low (fewer nutrients in the lake) compared to overall and 10-year averages, and was consistent across the sampling season.
- Average annual Chl-a was also the lowest on record at just 1.4 ppb.

Table 7. Summary of 2025 data and historical averages for water clarity, total phosphorus (TP), chlorophyll a (Chl-a), color, alkalinity, and pH at Sabbathday Lake. Average Maine lake values were obtained online from Maine DEP/Lake Stewards of Maine.

Date	Water Clarity (m)	TP (ppb)	Chl-a (ppb)	Color (PCU)	Alkalinity (ppm)	pH
7/10/2025	6.97	4.0	2.3	13.0	11.0	6.7
8/13/2025	8.20	3.0	1.0	11.0	12.0	6.6
9/11/2025	8.51	5.0	1.0	11.0	11.5	6.9
2025 Average	**7.9**	**4.0**	**1.4**	**11.7**	**11.5**	**6.7**
Historical Average	**6.7**	**6.3**	**3.7**	**11.8**	**11.0**	**7.0**
Average (Maine Lakes)	5.5	11.1	5.4	20.7	11.7	6.8

Sabbathday Lake experienced relatively little agal growth in 2025 based on measures of water clarity Chl-a, and phytoplankton. This is likely to the result of low levels of precipitation in late summer causing less influx of nutrients from the watershed during the period of strongest stratification. DO dropped to less than 2 ppm at the bottom of the lake in both August and September, allowing

[4] Likely due to the low density of *Gloeo* in the water at the time of sampling, and the small volume of water collected from the integrated core.

phosphorus to be released from bottom sediments. Bottom grab TP in September was almost four times higher than the concentration in the epilimnion. Phosphorus release from the bottom sediments should be monitored on an annual basis to assess long-term trends.

RECOMMENDATIONS

- **Continue collecting water samples** including phosphorus bottom grabs in Sabbathday Lake annually to maintain the long-term data set and for tracking of water quality trends over time.
- **Add 2019-2025 data to the DEP trend analysis** for the three primary trophic state indicators and pH.
- **Continue plankton sampling to establish a baseline** of phytoplankton and zooplankton in the lake.
- **Collect water quality data immediately after spring and fall turnover** to better understand the role of internal loading on P levels in Sabbathday Lake.
- **Continue ongoing watershed protection** activities in the watershed through the SDLA LakeSmart program and other educational programs.
- **Continue invasive plant prevention programs** including Courtesy Boat Inspections and Invasive Plant Patrols.
- **Track annual "ice-in" dates** in addition to "ice-out" dates to track long-term changes in ice cover.

RESOURCES FOR WATERSHED RESIDENTS

- **The Buffer Handbook:**
  http://www.maine.gov/dep/land/watershed/buffhandbook.pdf
- **The Buffer Handbook Plant List:**
  http://www.maine.gov/dep/land/watershed/buffer_plant_list.pdf
- **Caring for Your Septic System**
  https://cdn.branchcms.com/DrynVOJolO-1457/docs/Lake%20Library/Septic-two-pager-11x17-FINAL-5.14.21.pdf
- **Conservation Practices for Homeowners (24 fact sheets):**
  http://www.maine.gov/dep/land/watershed/materials.html
- **Erosion & Sediment Control BMPs**
  http://www.maine.gov/dep/land/erosion/escbmps/index.html
- **Gravel Road Maintenance Manual: A Guide for Landowners on Camp and Other Roads:**
  http://www.maine.gov/dep/land/watershed/camp/road/gravel_road_manual.pdf
- **The Lake Book: A Handbook for Lake Protection**
  https://www.lakes.me/lakebook

- **Maine Lakes LakeSmart Program:**
  https://www.lakes.me/lakesmart
- **Maine Stormwater Best Management Practices Manual**
  http://www.maine.gov/dep/land/stormwater/stormwaterbmps/index.html
- **Sabbathday Lake Online Water Quality Data**
  https://lakesofmaine.org/lake-overview.html?m=3700&singleton
- **Volunteer Water Quality Monitoring Training & Certification Information**
  https://www.lakestewardsofmaine.org/volunteer-programs-tools/certification/

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APPENDIX A- 2025 PHYTOPLANKTON RESULTS

* = potentially toxic ** = likely toxic # = taste and odor producer TAXON	PHYTOPLANKTON DENSITY (CELLS/ML) SABB 07/10/25	SABB 08/13/25	SABB 09/11/25	PHYTOPLANKTON BIOMASS (UG/L) SABB 07/10/25	SABB 08/13/25	SABB 09/11/25
BACILLARIOPHYTA						
Centric Diatoms						
Cyclotella/related taxa #	0	0	0	0.0	0.0	0.0
Urosolenia	0	0	0	0.0	0.0	0.0
Araphid Pennate Diatoms						
Single Fragilaria/Synedra	0	0	0	0.0	0.0	0.0
Tabellaria #	38	10	8	30.4	7.6	6.7
Monoraphid Pennate Diatoms						
Biraphid Pennate Diatoms						
CHLOROPHYTA						
Flagellated Chlorophytes						
Coccoid/Colonial Chlorophytes						
Filamentous Chlorophytes						
Desmids						
Staurastrum #	0	0	0	0.0	0.0	0.0
CHRYSOPHYTA						
Flagellated Classic Chrysophytes						
Chrysosphaerella #	285	86	0	114.0	34.2	0.0
Dinobryon #	48	19	8	142.5	57.0	25.2
Synura #	67	0	0	53.2	0.0	0.0
Other Flagellated Goldens	0	0	168	0.0	0.0	8.4
Non-Motile Classic Chrysophytes						
Haptophytes						
Tribophytes/Eustigmatophytes						
Raphidophytes						
CRYPTOPHYTA						
Cryptomonas #	0	19	25	0.0	3.8	5.0

* = potentially toxic ** = likely toxic # = taste and odor producer TAXON	PHYTOPLANKTON DENSITY (CELLS/ML) SABB 07/10/25	SABB 08/13/25	SABB 09/11/25	PHYTOPLANKTON BIOMASS (UG/L) SABB 07/10/25	SABB 08/13/25	SABB 09/11/25
CYANOPHYTA						
Unicellular and Colonial Forms						
Chroococcus	171	0	0	1.7	0.0	0.0
Filamentous Nitrogen Fixers						
Filamentous Non-Nitrogen Fixers						
*Pseudanabaena/Komvophoron * #*	0	0	84	0.0	0.0	0.8
EUGLENOPHYTA						
PYRRHOPHYTA						
Peridinium #	0	0	0	0.0	0.0	0.0
DENSITY (CELLS/ML) SUMMARY						
BACILLARIOPHYTA	**38**	**9.5**	**8.4**	**30.4**	**7.6**	**6.7**
Centric Diatoms	0	0	0	0.0	0.0	0.0
Araphid Pennate Diatoms	38	9.5	8.4	30.4	7.6	6.7
Monoraphid Pennate Diatoms	0	0	0	0.0	0.0	0.0
Biraphid Pennate Diatoms	0	0	0	0.0	0.0	0.0
CHLOROPHYTA	**0**	**0**	**0**	**0.0**	**0.0**	**0.0**
Flagellated Chlorophytes	0	0	0	0.0	0.0	0.0
Coccoid/Colonial Chlorophytes	0	0	0	0.0	0.0	0.0
Filamentous Chlorophytes	0	0	0	0.0	0.0	0.0
Desmids	0	0	0	0.0	0.0	0.0
CHRYSOPHYTA	**399**	**104.5**	**184.8**	**309.7**	**91.2**	**37.8**
Flagellated Classic Chrysophytes	399	104.5	184.8	309.7	91.2	37.8
Non-Motile Classic Chrysophytes	0	0	0	0.0	0.0	0.0
Haptophytes	0	0	0	0.0	0.0	0.0
Tribophytes/Eustigmatophytes	0	0	0	0.0	0.0	0.0
Raphidophytes	0	0	0	0.0	0.0	0.0
CRYPTOPHYTA	**0**	**19**	**25.2**	**0.0**	**3.8**	**5.0**
CYANOPHYTA	**171**	**0**	**84**	**1.7**	**0.0**	**0.8**
Unicellular and Colonial Forms	171	0	0	1.7	0.0	0.0
Filamentous Nitrogen Fixers	0	0	0	0.0	0.0	0.0
Filamentous Non-Nitrogen Fixers	0	0	84	0.0	0.0	0.8
EUGLENOPHYTA	**0**	**0**	**0**	**0.0**	**0.0**	**0.0**
PYRRHOPHYTA	**0**	**0**	**0**	**0.0**	**0.0**	**0.0**
TOTAL	**608**	**133**	**302.4**	**341.8**	**102.6**	**50.4**
DIVERSITY	**0.58**	**0.45**	**0.52**	**0.55**	**0.44**	**0.62**

* = potentially toxic ** = likely toxic # = taste and odor producer	**PHYTOPLANKTON DENSITY (CELLS/ML)**			**PHYTOPLANKTON BIOMASS (UG/L)**		
TAXON	**SABB 07/10/25**	**SABB 08/13/25**	**SABB 09/11/25**	**SABB 07/10/25**	**SABB 08/13/25**	**SABB 09/11/25**
EVENNESS	**0.82**	**0.74**	**0.66**	**0.78**	**0.73**	**0.79**
NUMBER OF TAXA						
BACILLARIOPHYTA	**1**	**1**	**1**			
Centric Diatoms	0	0	0			
Araphid Pennate Diatoms	1	1	1			
Monoraphid Pennate Diatoms	0	0	0			
Biraphid Pennate Diatoms	0	0	0			
CHLOROPHYTA	**0**	**0**	**0**			
Flagellated Chlorophytes	0	0	0			
Coccoid/Colonial Chlorophytes	0	0	0			
Filamentous Chlorophytes	0	0	0			
Desmids	0	0	0			
CHRYSOPHYTA	**3**	**2**	**3**			
Flagellated Classic Chrysophytes	3	2	3			
Non-Motile Classic Chrysophytes	0	0	0			
Haptophytes	0	0	0			
Tribophytes/Eustigmatophytes	0	0	0			
Raphidophytes	0	0	0			
CRYPTOPHYTA	**0**	**1**	**1**			
CYANOPHYTA	**1**	**0**	**1**			
Unicellular and Colonial Forms	1	0	0			
Filamentous Nitrogen Fixers	0	0	0			
Filamentous Non-Nitrogen Fixers	0	0	1			
EUGLENOPHYTA	**0**	**0**	**0**			
PYRRHOPHYTA	**0**	**0**	**0**			
TOTAL	**5**	**4**	**6**			
DENSITY (UG/L) SUMMARY						
BACILLARIOPHYTA				30	8	7
CHLOROPHYTA				0	0	0
CHRYSOPHYTA				310	91	38
CRYPTOPHYTA				0	4	5
CYANOPHYTA				2	0	1
EUGLENOPHYTA				0	0	0
PYRRHOPHYTA				0	0	0