Water Quality Summary: Chlorophyll-a

2024 Barr Lake & Milton Reservoir

Barr Lake and **Milton Reservoir**'s water quality has been sampled twenty times a year since 2003. These 440 trips to both reservoirs have produced an abundance of data and information. This is Part 2 of 8 of a water quality summary series for 2024 calendar year for both reservoirs. The first summary focused on pH; this one discusses chlorophyll-a (Chl-a).

The Big Picture – Eutrophication is the addition of nutrients and sediments to water bodies resulting in algae and plant growth and sedimentation. This natural process occurs over a long geological period - 1,000's of years. Many lakes, reservoirs, ponds, and even estuaries throughout the world experience "*cultural eutrophication*". This term means that water bodies become more productive and shallower much quicker (months to years) due to increased inputs of nutrients and sediments from human activities. This unnaturally accelerated aging of lakes causes a biological response – algae growth that usually leads to blue-green algal scums. This biological response then triggers chemical and physical changes within the water – pH, oxygen, water clarity and color, fish, water safety, plants, and aesthetics.

Chl-a – This is the measurement of how much green pigment is in the water. Algae, like trees and grasses, produce chl-a through photosynthesis causing the plant to be green. Chl-a is essential in the plant's process of transforming sunlight into biomass. By measuring how green the water is, one can get a relative understanding about how much algal growth is occurring. Chl-a concentrations are expressed in units of micrograms per liter (µg/L) or parts per billion (ppb). Chl-a is not an exact measurement of biomass. Some algae (e.g., diatoms) don't produce as much chl-a as others (e.g., blue-green algae) and can change their rate of chl-a production throughout the day. Chl-a is not the same as the rate of productivity or an indicator of how fast the algae are growing. Concentrations below 5 µg/L are considered low, and values greater than 25 µg/L are considered high.

Chl-a around 85 ug/L at Barr Lake (07/15/03)

Too much algal growth is the main observable symptom resulting from *cultural eutrophication*. Too much growth leads to aesthetic issues, odor problems, cyanotoxins, dissolved oxygen fluctuations, and lower water clarity. Typically, more algae mean more zooplankton and more fish. However, there can be a tipping point where too much algae becomes harmful. The water quality standard for chl-a for warm water reservoirs is 20 µg/L averaged over the growing season (July 1 – September 30). The chl-a target that has been determined for **Barr Lake** and **Milton Reservoir** is 25 µg/L or less during the growing season.

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2024 Chl-a Data – A 1-meter depth water sample is collected and filtered (200 – 1,000 milliliters) in the boat during each site visit. The filter paper collects the algae contained in that water sample and is analyzed. For 2024, there were 20 chl-a concentrations recorded for both Barr and Milton (Table 1).

Table 1. Barr and Milton 2024 chl-a data (ug/L). Bold values exceed the water quality standard of 20 µg/L.

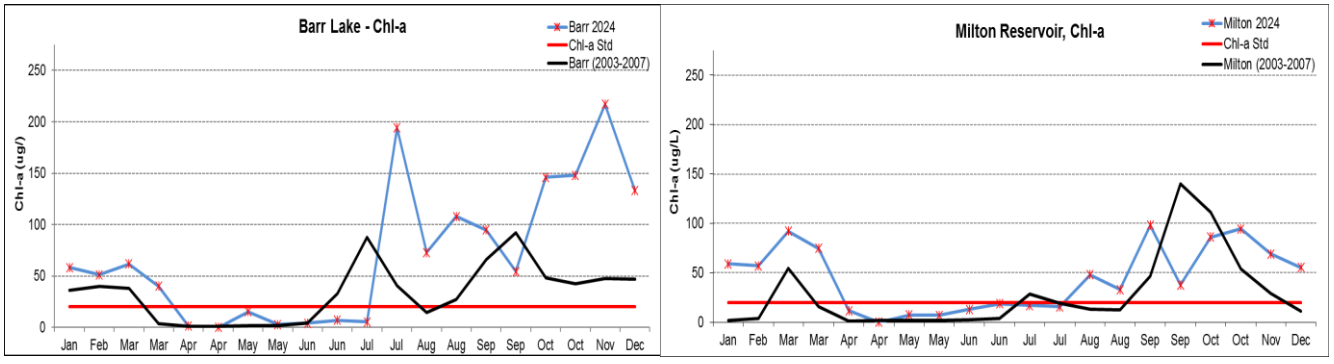
Month	Chl-a (Barr)	Chl-a (Milton)
Jan	58.2	59.1
Feb	51.1	56.9
Mar	61.8	92.1
Mar	39.9	74.8
Apr	1.1	11.5
Apr	<0.1	<0.1
May	15.3	7.1
May	2.8	6.7
Jun	4.1	12.8
Jun	6.9	18.6
Jul	5.4	16.9
Jul	**194.0**	15.7
Aug	**73.0**	**48.1**
Aug	**108.0**	**33.1**
Sep	**94.9**	**98.1**
Sep	**54.5**	**37.6**
Oct	146.0	86.1
Oct	148.0	94.4
Nov	217.0	69.1
Dec	133.0	55.3

The median* chl-a for **Barr Lake** in 2024 was 56.4 µg/L and 42.9 µg/L for **Milton Reservoir**. The large algal community that occurred in both reservoirs in the late fall not only caused an increase in pH but also an increase in chl-a. As with pH, the chl-a decreased by April before the warmer growing season. Barr didn't have a summer bloom until late July. Milton's major summer bloom was in September.

The growing season median for **Barr Lake** was 84.0 µg/L and 35.4 µg/L for **Milton Reservoir**. With large fluctuations in values, the median is a better estimate of the middle when it comes to chl-a. The range at Barr went from 5.4 µg/L to 194.0 µg/L in less than two weeks' time.

Figure 1 shows the annual cycle, goal, and 2024 results for chl-a. **Milton Reservoir** had an active winter followed by below average values for the growing season. The summer blooms never formed scums and were short lived. **Barr Lake** had a great first six months followed by a steady growth of cyanobacteria. Chl-a in Barr Lake almost doubled compared to 2023 despite similar nutrient levels. Opposite, Milton had about half as much chl-a compared to 2023. Both reservoir and weather conditions, unique to 2023 (drawdowns and heat waves), did shape the algal growth, especially for Barr Lake.

Figure 1. 2024 chl-a data compared to WQ target and 2003-2007 annual average.



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Photosynthesis – This important biochemical process has a major impact on Barr Lake and Milton Reservoir. The process of photosynthesis converts CO_2 into organic matter (sugar) by using energy from the sun. An evaluation of chl-a provides a good representation of the primary biomass in a lake. Photosynthesis helps determine the balance between pH (changes in CO_2), organic matter (chl-a or algae), nutrients, and dissolved oxygen.

$$6CO_2 + 6H_2O + Nutrients \underset{\text{(Respiration/Decomposition)}}{\overset{\text{(Photosynthesis)}}{\rightleftharpoons}} C_6H_{12}O_6 + 6O_2$$

** median is used instead of average because chl-a data has a large range of values and can change quickly. Median does a better job of representing the middle of a data set that has extremely high and low values. The state standard uses the average between July 1 and September 30.*