Water Quality Summary: Chlorophyll-a

2020 Barr Lake & Milton Reservoir

Twenty times a year since 2003, **Barr Lake** and **Milton Reservoir** have been sampled for water quality. These 360 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 2020 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 unnatural, accelerated aging of lakes causes an obvious biological response – algae growth that usually leads to blue-green algal scums. This biological response then leads to chemical and physical changes within the water – pH, oxygen, water clarity and color, fish, water safety, plants, and aesthetics can all impact the health of the water.

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

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 algae there are. 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, but it is close. 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.

Too much algal growth is the main observable symptom resulting from *cultural eutrophication*. Too much growth leads to aesthetic issues, odor problems, cyanotoxins, large dissolved oxygen fluctuations, and lower water clarity. Typically, more algae mean more zooplankton and more fish. However, there can be a point where too much algae harms fish and zooplankton. 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. This target is not specified as an average or median.

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2020 Chl-a Data – Approximately 1 liter of 1-meter depth water is collected and filtered in the boat during each site visit. The filter paper collects the algae contained in that one liter of water and is analyzed for Chl-a. For 2020, there were 19 Chl-a concentrations recorded for both Barr and Milton (Table 1).

Table 1. Barr and Milton 2020 Chl-a data (ug/L). Bold values exceed the water quality target of 20 µg/L.

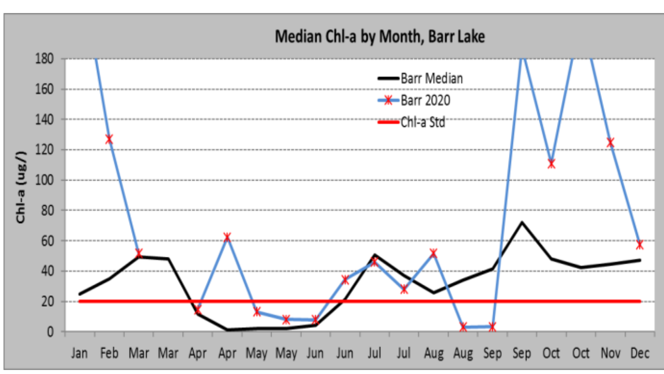
Month	Chl-a (Barr)	Chl-a (Milton)
Jan	243.0	71.0
Feb	127.0	112.0
Mar	51.6	138.0
Mar	NA	NA
Apr	14.7	109.0
Apr	62.3	4.2
May	13.2	39.9
May	8.2	43.4
Jun	7.9	60.1
Jun	34.4	28.8
Jul	**46.0**	**26.0**
Jul	**28.0**	**38.0**
Aug	**51.6**	**60.2**
Aug	3.2	3.2
Sep	3.3	6.4
Sep	**187.0**	**67.0**
Oct	111.0	103.0
Oct	209.0	96.1
Nov	125.0	98.3
Dec	57.3	114.0

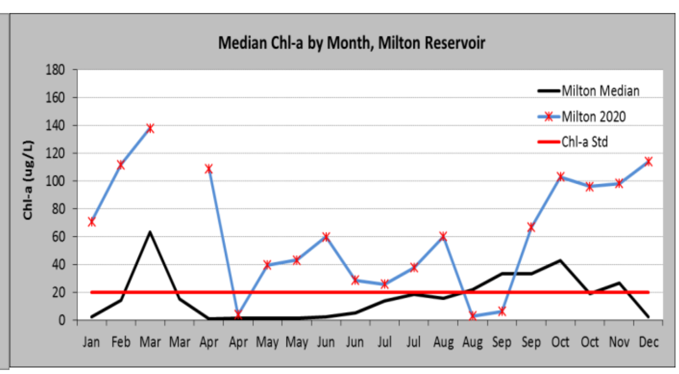
The median* Chl-a for **Barr Lake** in 2020 was 51.6 µg/L and 60.2 µg/L for **Milton Reservoir**. The large algal community that occurred in both reservoirs in the winter and fall not only caused an increase in pH but also an increase in Chl-a. As with the pH, the Chl-a decreased by April/May before the warmer growing season. Barr did have a bloom in late summer that formed surface scums but not as bad as 2019.

The growing season median for **Barr Lake** was 37.0 µg/L and 32.0 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. In September, Chl-a changed by 184 µg/L in just two weeks.

Figure 1 shows the annual cycle, goal, and 2020 results for Chl-a. **Milton Reservoir** had low Chl-a April and late summer. This was followed by moderate growth during the summer and then an increase during the fall. **Barr Lake** had two large diatom blooms in Jan/Feb and late April. Barr did experience a smaller cyanobacteria bloom in July. What is most notable was the significant increase in Chl-a starting in late September and lasting the rest of the year. Barr experienced an extended and severe drawdown that started in September. Barr Lake was only 6 feet deep or approximately 95% of full volume for close to 30 days.

Figure 1. 2020 Chl-a data compared to WQ target and 2003-2020 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.

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

** 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 extreme high values along with extreme low values. The state standard applies the average between July 1 and September 30.*