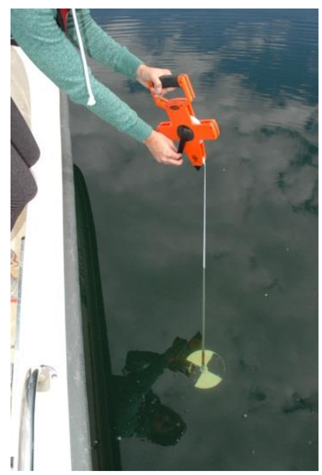
Twenty times a year since 2003, **Barr Lake** and **Milton Reservoir** have been sampled for water quality. These 360 trips to both reservoirs have produced an abundance of data and information. This is Part 7 of 8 of a water quality summary series for 2020 calendar year for both reservoirs. The other summaries focused on pH, Chl-a, oxygen, temperature, phosphorus, and nitrogen; this one discusses water clarity.

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.

Secchi Depth – This is the measurement of water clarity. There are many influences on water clarity - algae, zooplankton, silt/dirt, precipitants, and anything else that is suspended in the water. Water also has dissolved compounds (e.g., tannic acids from decomposing organic matter) that change the color of water and impact clarity. Water clarity is mostly influenced by planktonic algae in Barr and Milton. During major rain events, incoming water can be turbid from dirt and urban runoff. Clarity is another response variable reflecting the overall condition of the reservoir and the watershed.



Measuring water clarity with a Secchi Disk on the shady side of the boat

Water clarity is expressed in units of meters (m) or feet (ft) and measured with a Secchi disk. The disk is an 8" diameter, black and white weighted disk that is lowered in the water until it disappears. This practice of measuring water clarity has been around since 1865 and is a useful way to quickly measure the health of a lake and track water quality changes. Volunteers across the country use the Secchi disk as part of citizen science-based lake monitoring programs.

People are comfortable getting into the water and being able to see their feet. Water clarity of 2.0 m (6.5 ft) or better is considered desirable. There is no state wide standard for water clarity, but clarity over 2.0 m would be desirable for **Barr** and **Milton**.

Water Quality Summary: Water Clarity

2020 Barr Lake & Milton Reservoir

2020 Water Clarity Data – Secchi depth is measured from the shady side of the boat during each visit. The disk is attached to a tape measure. The disk is first lowered until it disappears, at which point a measurement is taken, representing the lowering depth. The disk is lowered a couple of meters deeper and raised until the disk reappears, representing the raising depth. The average of the lowering and raising depth is the Secchi depth. For 2020, there were 19 depths recorded for each reservoir (Table 1).

Table 1. Barr Lake and Milton Reservoir 2020 clarity data (m and ft). Bold values are less than 2 meters.

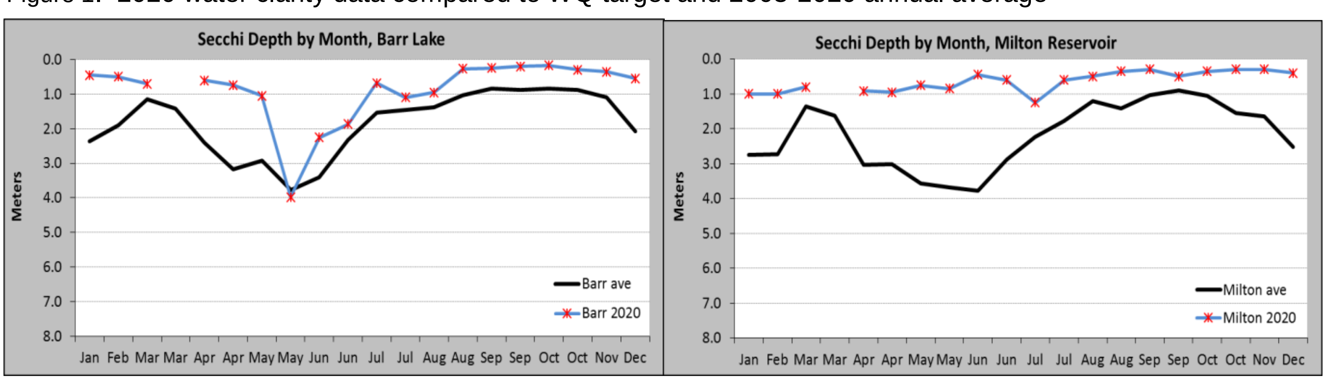
Month	Secchi Depth (Barr)	Secchi Depth (Milton)
Jan	**0.45 m (1.5 ft)**	**1.00 m (3.3 ft)**
Feb	**0.50 m (1.6 ft)**	**1.00 m (3.3 ft)**
Mar	**0.70 m (2.3 ft)**	**0.80 m (2.6 ft)**
Mar	**NA**	**NA**
Apr	**0.60 m (2.0 ft)**	**0.92 m (3.0 ft)**
Apr	**0.74 m (2.4 ft)**	**0.95 m (3.1 ft)**
May	**1.05 m (3.4 ft)**	**0.75 m (2.5 ft)**
May	3.98 m (13.1 ft)	**0.85 m (2.8 ft)**
Jun	2.25 m (7.4 ft)	**0.45 m (1.5 ft)**
Jun	**1.87 m (6.1 ft)**	**0.60 m (2.0 ft)**
Jul	**0.68 m (2.2 ft)**	**1.25 m (4.1 ft)**
Jul	**1.10 m (3.6 ft)**	**0.60 m (2.0 ft)**
Aug	**0.95 m (3.1 ft)**	**0.50 m (1.6 ft)**
Aug	**0.27 m (0.9 ft)**	**0.35 m (1.1 ft)**
Sep	**0.25 m (0.8 ft)**	**0.30 m (1.0 ft)**
Sep	**0.20 m (0.7 ft)**	**0.50 m (1.6 ft)**
Oct	**0.17 m (0.6 ft)**	**0.35 m (1.1 ft)**
Oct	**0.30 m (1.0 ft)**	**0.30 m (1.0 ft)**
Nov	**0.35 m (1.1 ft)**	**0.30 m (1.0 ft)**
Dec	**0.55 m (1.8 ft)**	**0.40 m (1.3 ft)**

The average Secchi depth for **Barr Lake** in 2020 was 0.89 m and 0.64 m for **Milton Reservoir**. 2020 had the lowest annual average ever for both reservoirs. Both reservoirs experienced a shorter spring clearing then normal.

The growing season (July 1 – September 30) average for **Barr Lake** was 0.58 m and 0.58 m for **Milton Reservoir**. Typically, the growing season average is lower than the annual average because of increased algal growth during this period.

Figure 1 shows the annual cycle and 2020 results for water clarity. **Barr Lake's** clarity changed in response to algal activity and water depth. Both systems are driven by algal growth when it comes to water clarity. **Milton Reservoir** never really experienced the spring clearing phase. Barr Lake also had a shortened clearing phase. For most of the year both reservoirs had less than average clarity. The severe drawdown at Barr Lake did create conditions to grow algae and to have sediments re-suspended by wind action and bioturbation (i.e., carp). Milton, despite the lowest average clarities ever recorded, did not have any more algal blooms or aesthetic issues. The key was the type of algal species that dominated. For Milton, cyanobacteria did not bloom to nuisance levels while Barr flirted with blooms during the summer.

Figure 1. 2020 water clarity data compared to WQ target and 2003-2020 annual average



TSI Score – The Trophic Status Index (TSI) is a scoring system that measures the eutrophic level of a lake or reservoir by using water clarity, phosphorus, and Chl-a. The widely used Carlson TSI was developed by Bob Carlson in 1977. The Carlson TSI is a way to integrate complicated environmental measurements into a single score that is comparable between lakes. The TSI works well in north temperate lakes that are phosphorus limited. The TSI is not a perfect fit for Barr and Milton but you can learn from it. This is the reason why the average TSI is much different compared to the TSI score associated with just water clarity. The phosphorus TSI scores are in the hypereutrophic range (off the chart even) while the water clarity is more eutrophic (Figure 2). The TSI values within the eutrophic to mesotrophic range (45 – 60) seem to be a reasonable score for warm-water, shallow reservoirs such as Barr Lake and Milton Reservoir.

Figure 2. 2020 TSI scores for Barr and Milton, July - September