Water Quality Summary: pH

2019 Barr Lake & Milton Reservoir

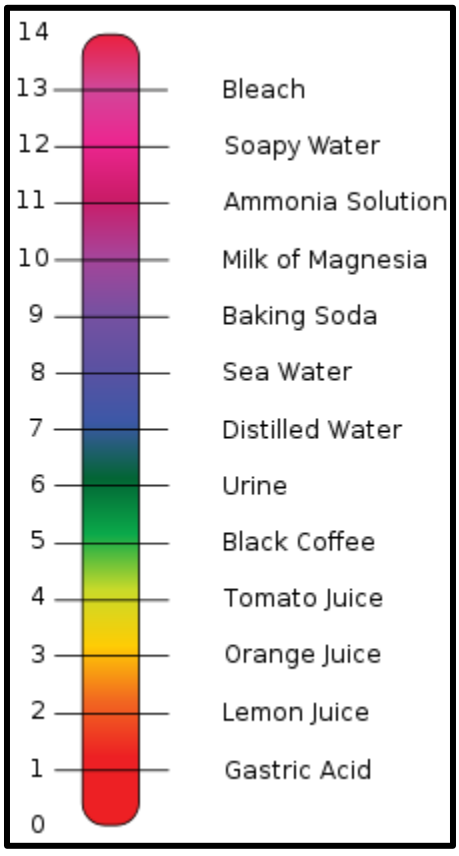
Twenty times a year since 2003, **Barr Lake** and **Milton Reservoir** have been sampled for water quality. These 340 trips to both reservoirs have produced an abundance of data and information. This is Part 1 of 8 of a water quality summary series for 2019 calendar year for both reservoirs. This first summary focuses on pH.

The Big Picture – Eutrophication is the addition of nutrients to water bodies resulting in nuisance algae growth and sedimentation. This natural process usually occurs over a long geological period of time. Many lakes, reservoirs, and even estuaries and bays throughout the world experience "*cultural eutrophication*". This term means that water bodies tend to become more productive and shallower over relatively short periods of time due to increased inputs of nutrients and sediments from human activities. Accelerated aging of lakes causes a quick biological response – severe algae growth. This response then leads to other chemical and physical changes within the water – pH, oxygen, water clarity and color, fish, plants, and aesthetics can all change.

pH – This is the measurement of how many hydrogen ions (H^+) are in the water (scale is 1 through 14). The higher the concentration of H^+, the more acidic or lower the number (scale of 1-6). The lower the H^+ concentration, the more basic or higher the number (scale of 8-14). Pure water has a neutral pH around 7.0. Normal rainfall is about 5.6 because of exposure to the air.

Colorado's water quality standard for pH is between 6.5 and 9.0. To determine if a lake is satisfying this standard, pH data are collected from the surface (epilimnion) to the bottom of the lake (hypolimnion). pH is important when it comes to aquatic organisms such as fish.

2019 pH Data – For Barr Lake and Milton Reservoir, pH data are collected throughout the entire water column in half meter increments during each visit. pH measurements from 0.5 meter to 2.0 meters are then averaged for each visit for the top water. For 2019, there were 20 pH averages recorded for each reservoir (Table 1). The data are then ranked from highest to lowest. The 85th percentile pH value is the one that has 15% of the values higher and 85% of the values lower. For **Barr Lake**, the 2019 85th percentile pH value was 9.15 and for **Milton Reservoir** it was 9.26. Milton has met the pH standard for three out of the six past years.



pH Scale 1 to 14

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Table 1. 2019 Barr Lake and Milton Reservoir average pH for the top water (0.5 – 2.0 m) for each sampling event and the 85th percentile. Bold values exceed the water quality standard.

Barr Lake				Milton Reservoir			
Month	**pH**	**Rank**	**%tile**	**Month**	**pH**	**Rank**	**%tile**
Jan	**9.16**	**9.37**	***100***	**Jan**	8.71	**9.54**	***100***
Feb	**9.37**	**9.16**		**Feb**	**9.29**	**9.29**	
Mar	8.96	**9.15**	***90***	**Mar**	**9.16**	**9.27**	***90***
Mar	8.97	**9.15**	***85***	**Mar**	**9.54**	**9.26**	***85***
Apr	**9.15**	**9.11**	***80***	**Apr**	**9.26**	**9.16**	***80***
Apr	8.79	8.97		**Apr**	**9.27**	**9.13**	
May	8.70	8.96	***70***	**May**	8.41	8.94	***70***
May	8.68	8.91		**May**	8.11	8.81	
Jun	8.43	8.79	***60***	**Jun**	8.01	8.80	***60***
Jun	8.16	8.78		**Jun**	7.95	8.80	
Jul	8.46	8.74	***50***	**Jul**	8.54	8.71	***50***
Jul	8.57	8.74		**Jul**	8.38	8.71	
Aug	8.69	8.70	***40***	**Aug**	8.94	8.55	***40***
Aug	8.74	8.69		**Aug**	8.80	8.54	
Sep	8.74	8.68	***30***	**Sep**	8.55	8.53	***30***
Sep	8.78	8.65		**Sep**	8.81	8.41	
Oct	8.65	8.57	***20***	**Oct**	8.71	8.38	***20***
Oct	8.91	8.46		**Oct**	8.53	8.11	
Nov	**9.11**	8.43	***10***	**Nov**	8.80	8.01	***10***
Dec	**9.15**	8.16		**Dec**	**9.13**	7.95	

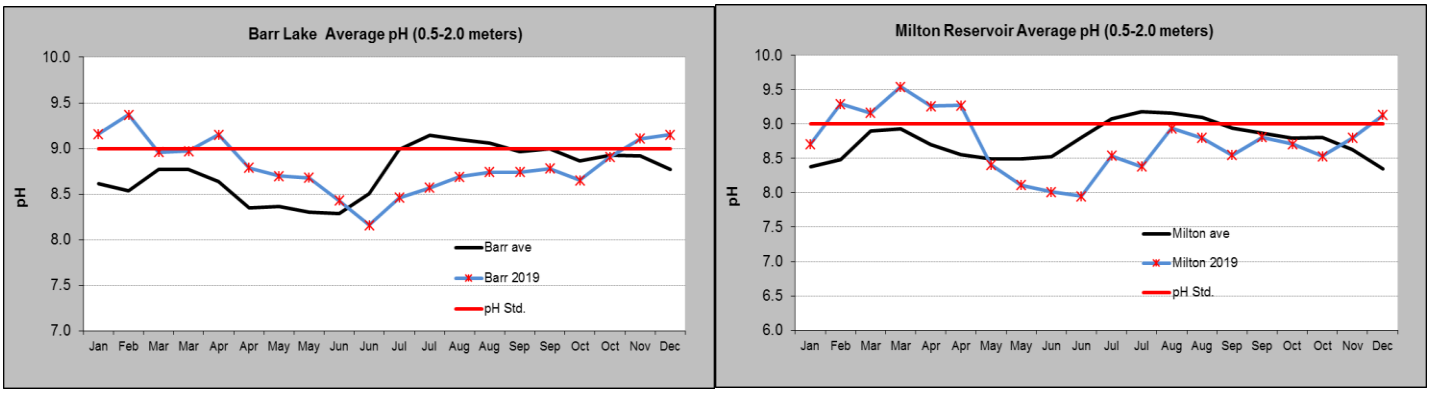
There is no seasonality for the pH standard, all data collected in a year are included in the calculations.

With 20 sampling events, only three can be higher than 9.0. The fourth highest pH value is the 85th percentile number.

The median (50th percentile) pH for **Barr Lake** in 2019 was 8.76 and for **Milton Reservoir** it was also 8.76. Both reservoirs experienced a typical spring time diatom bloom and Barr had a major bloom at the end of July. The lowest pH for both Barr and Milton occurred in June after the spring diatom growth. All pH exceedances occurred in the fall or spring.

Figures 1 shows the annual pH patterns, upper pH standard, and 2019 pH values. The annual algae growth cycle determines the annual pH pattern. It is important to notice that the background pH is over 8.0 so there is not much room for higher pH values.

Figure 1. 2019 pH data compared to WQ target and 2003-2019 annual average



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Algae and pH – How does the growth of algae change the pH of a lake? When algae grow, they photosynthesize. This is the process of taking in CO_2 and water in the presence of sunlight and producing oxygen and sugar (food) for growth. Taking CO_2 out of the water results in less carbonic acid (H_2CO_3). Less carbonic acid means less H^+ in the water, and therefore a higher pH. If the algae grow fast, the reservoir does not have enough time to get back into equilibrium with the atmosphere to dissolve more CO_2.

The opposite can also occur; decomposition of the algae at the lake bottom consumes oxygen and produces CO_2. Bottom water can get below pH of 6.0 (acidic) because of the carbonic acid formation. Due to water movement and alkalinity (ability of the water to neutralize acids), this does not happen in **Barr Lake** or **Milton Reservoir**.