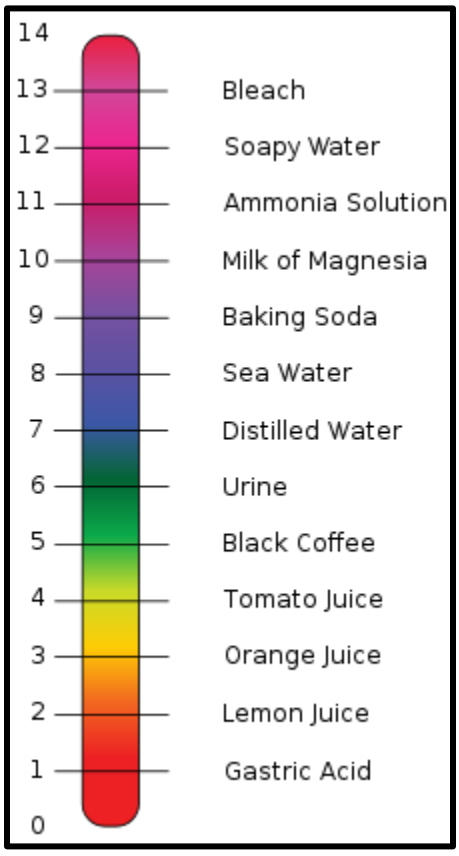
2015 Water Quality Summary Series - pH

Since 2003, water quality scientists have observed and sampled Barr Lake and Milton Reservoir twenty times a year by the dam for a variety of water quality parameters. These 240 trips to both reservoirs have produced an abundance of data and information. This is Part 1 of 8 2015 water quality summaries. This first summary focuses on pH and how it compares to other years.

The Big Picture – 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 impacts in the watershed. Eutrophication is a natural process, but it generally occurs over a much longer geological period. This 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 column– pH, oxygen, water clarity, water color, and aesthetics.

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.



For fish and other aquatic organisms and to satisfy Colorado's water quality standard for lakes, the desired range is 6.5 to 9.0. To determine if a lake is satisfying this standard, pH data is collected from the surface (epilimnion) and bottom of the lake (hypolimnion).

2015 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 data from 0.5 meter to 2.0 meters are then averaged for each visit for the top water. For 2015, there were 20 pH averages recorded for each reservoir (Table 1). The data is 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 2015 85th percentile pH value was 8.98 and for **Milton Reservoir** it was 8.95. For the third consecutive time, Barr Lake met the pH standard. For Milton, this was twice in three years.

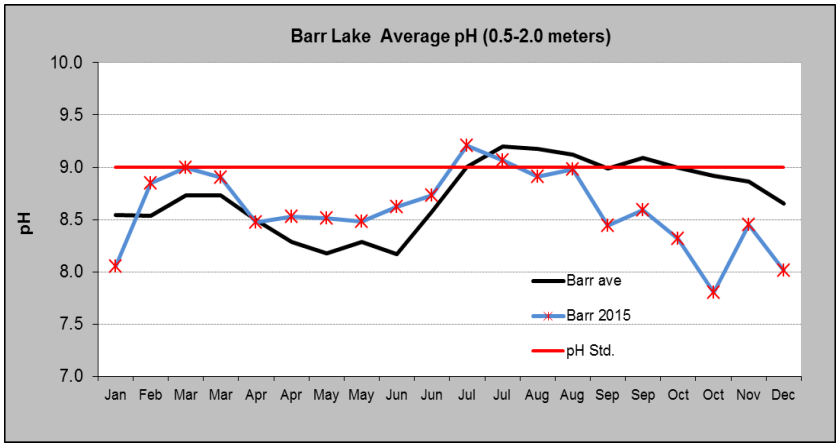
Table 1. 2015 Barr Lake and Milton Reservoir average pH for the top water (0.5 – 2.0 m) for each sampling event and the 85th percentile. Bold values exceed the water quality standard.

Barr Lake				Milton Reservoir			
Month	**pH**	**Rank**	**%tile**	**Month**	**pH**	**Rank**	**%tile**
Jan	8.05	**9.21**	***100***	**Jan**	8.43	**9.25**	***100***
Feb	8.85	**9.07**		**Feb**	8.73	**9.14**	
Mar	**9.00**	**9.00**	***90***	**Mar**	**9.25**	8.97	***90***
Mar	8.90	8.98	***85***	**Mar**	8.97	8.95	***85***
Apr	8.47	8.91	***80***	**Apr**	7.73	8.90	***80***
Apr	8.53	8.90		**Apr**	8.06	8.89	
May	8.51	8.85	***70***	**May**	8.34	8.86	***70***
May	8.48	8.73		**May**	8.21	8.84	
Jun	8.62	8.62	***60***	**Jun**	8.57	8.79	***60***
Jun	8.73	8.59		**Jun**	8.79	8.73	
Jul	**9.21**	8.53	***50***	**Jul**	8.84	8.70	***50***
Jul	**9.07**	8.51		**Jul**	8.95	8.63	
Aug	8.91	8.48	***40***	**Aug**	8.89	8.57	***40***
Aug	8.98	8.47		**Aug**	**9.14**	8.43	
Sep	8.44	8.45	***30***	**Sep**	8.70	8.34	***30***
Sep	8.59	8.44		**Sep**	8.63	8.21	
Oct	8.32	8.32	***20***	**Oct**	7.11	8.06	***20***
Oct	7.80	8.05		**Oct**	8.86	7.73	
Nov	8.45	8.01	***10***	**Nov**	8.90	7.11	***10***
Dec	8.01	7.80		**Dec**	6.66	6.66	

The average pH for **Barr Lake** in 2015 was 8.60 and for **Milton Reservoir** it was 8.49. Both reservoirs experienced a typical spring time diatom bloom but then had a mild summer of algae growth. The lowest pH for Barr Lake occurred in October when the reservoir was still relatively full. For Milton, the lowest pH occurred during December when the reservoir started refilling after being almost completely drained.

Applying the same statistical methods to just the growing season (July – September), **Barr Lake's** 85th percentile would have been 9.11 and 8.87. **Milton Reservoir's** 85th percentile would have been 9.00 and 8.86. Most of the growing season numbers are higher because of a focus on the three months of greater algae growth that causes the higher pH values.

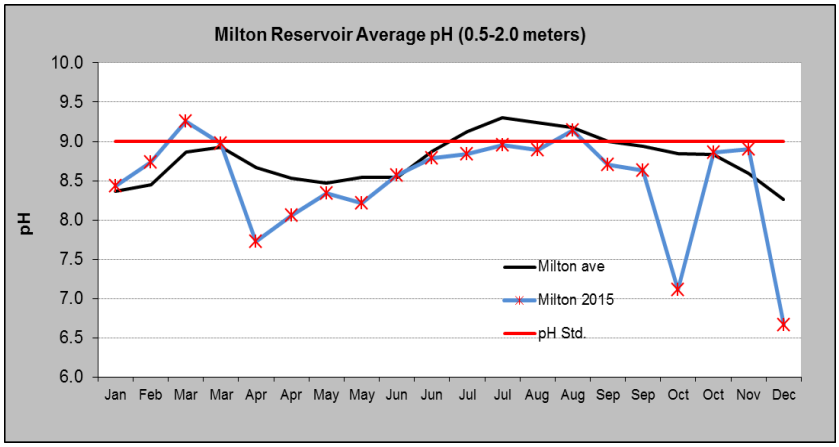
Figure 1



Figures 1 and 2 show the annual pH patterns, pH standard, and 2015 pH numbers.

Algae and pH – How does the growth of algae change the pH of a lake? When algae grow, they undergo photosynthesis. 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 too fast, the reservoir does not have enough time to get back into equilibrium with the atmosphere to dissolve more CO_2.

Figure 2



The opposite can occur; decomposition of the algae at the lake bottom takes in 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**.