

April 2019

Brush Lake

(47.52956 N, -100.72583 W)

McLean County

- Brush Lake is a popular natural lake in central North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/brush2005.pdf>)
- There is one paved, public boat ramp on the southeast side of Brush Lake.
- The Brush Lake watershed is about 32,000 acres of mostly grassland/pasture and agricultural land. The most common crops grown are spring wheat, soybeans and corn (Table 1).
- Brush Lake is a Class III fishery, which are “capable of supporting natural reproduction and growth of warm water fishes (e.g., largemouth bass and bluegill) and associated aquatic biota.”
- Brush Lake is managed for walleye, with fingerlings stocked biennially. Yellow perch, white sucker and northern pike were also found during the last sample by the ND Game and Fish.
- Brush Lake was previously assessed in 1991-1992, 2005-2006 and 2010-2011.

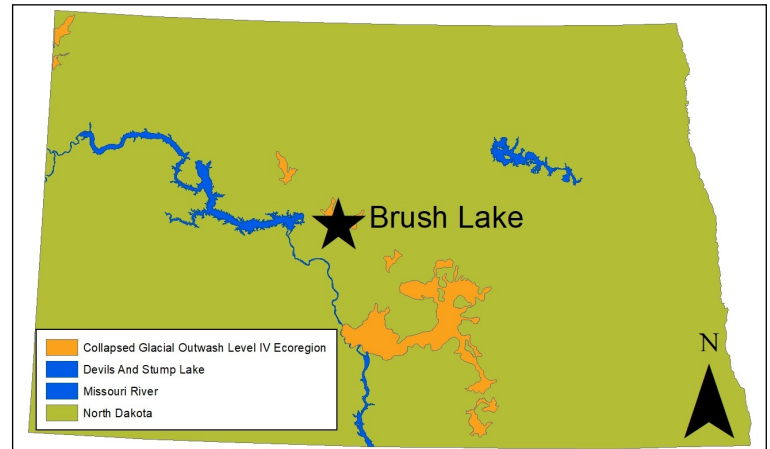


Figure 1. Location of Brush Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2017). Value listed of crop type represents percentage of total production.

Land Cover Type	% in Watershed	% within 500 meters
Grassland/Pasture	51.8%	56.3%
Agriculture	32.8%	6.6%
Spring Wheat	35.7%	3.2%
Soybeans	31.7%	3.2%
Corn	10.3%	3.6%
Open Water	6.0%	17.5%
Wetlands	4.7%	8.1%
Developed	4.2%	11.1%
Forest	0.5%	0.4%

Temperature and Dissolved Oxygen

- Brush Lake stratifies in the summer, with warm, well-oxygenated water at the top of the water column, and cold, low-oxygen water near the bottom.
- There was thermal stratification in May of 2018. Temperature change in the water column was 5.48 degrees Celsius (°C), 0.05°C and 0.01°C in May, July and September, respectively.
- All samples showed most of the lake as well-oxygenated, with only near-bottom concentration during thermal stratification.

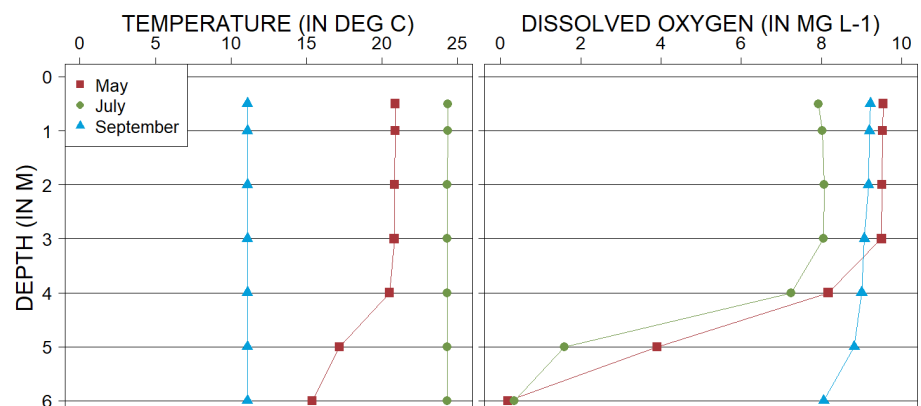


Figure 2. 2018 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ($mg L^{-1}$)

Trophic State Indices

- Trophic state is a measure used by scientists to assess the condition (where lower scores indicate better water quality) of a lake using three common measures: total phosphorus (TP), Secchi disk transparency and chlorophyll-a concentration.
- Brush Lake is a eutrophic lake (Figure 3) that has moderate nutrient concentrations and moderate algal growth.
- Current trophic state is similar to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Brush Lake.

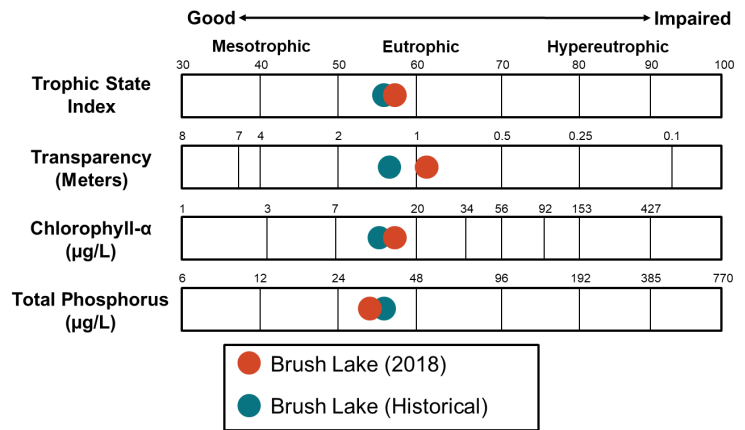


Figure 3. Trophic state indices for 2018 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2018 was similar to the historical median but less than the median for the Collapsed Glacial Outwash Level IV Ecoregion (hereafter, Glacial Outwash) where Brush Lake is located (Figure 4).
- Median concentration of dissolved TN was slightly less than TN.
- Median TP concentration was lower in 2018 compared to historical concentrations and the median for the Glacial Outwash (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia was only detected once (and at a low concentration) in Brush Lake in 2018, while there were no detections of nitrate plus nitrite.

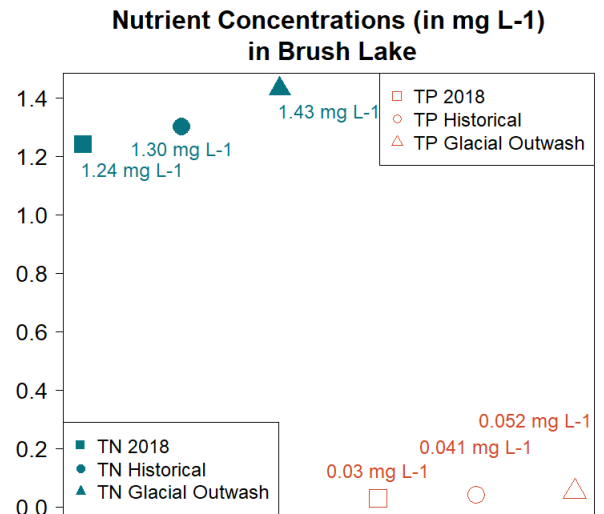


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2018 and historical samples and from all Glacial Outwash lakes.

Measure	2018 Median	Historical Median	Ecoregion Median
Alkalinity	426 mg L ⁻¹	440 mg L ⁻¹	466 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	446 mg L ⁻¹	463 mg L ⁻¹	464 mg L ⁻¹
Calcium (Ca ²⁺)	30.6 mg L ⁻¹	32.0 mg L ⁻¹	25.3 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	30 mg L ⁻¹	37 mg L ⁻¹	58 mg L ⁻¹
Conductivity	1,180 µS cm ⁻¹	1,215 µS cm ⁻¹	1,770 µS cm ⁻¹
Dissolved Solids	768 mg L ⁻¹	779 mg L ⁻¹	1,240 mg L ⁻¹
Magnesium (Mg ²⁺)	71.7 mg L ⁻¹	76.6 mg L ⁻¹	88 mg L ⁻¹
Sodium (Na ⁺)	145 mg L ⁻¹	143 mg L ⁻¹	163 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	227 mg L ⁻¹	231 mg L ⁻¹	554 mg L ⁻¹

- Sulfate and bicarbonate are co-dominant anions in Brush Lake, while sodium and magnesium are co-dominant cations (Figure 5).
- Median concentrations of most cations and anions are similar to the historical median for the lake but less than the median for the Glacial Outwash.

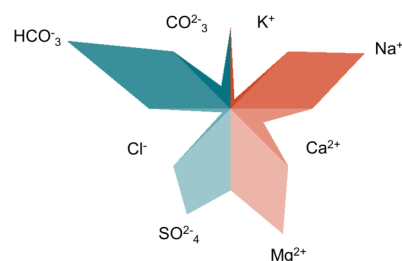


Figure 5. Maucha diagram showing ionic balance based on 2018 data