

April 2019

Lake Holmes

(47.53479 N, -100.87110 W)

McLean County

- Lake Holmes is a large, natural lake in central North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/holmes2003.pdf>)
- There is one paved, public boat ramp on the north side of Lake Holmes.
- The Lake Holmes watershed is about 4,000 acres of mostly agriculture, grassland/pasture and open water. The most common crops grown are spring wheat, soybeans and non-alfalfa hay (Table 1).
- Lake Holmes is a Class II fishery, which are “capable of supporting natural reproduction and growth of cool water fishes (e.g., northern pike and walleye) and associated aquatic biota.”
- Lake Holmes is managed for walleye, with fingerlings stocked biennially. Yellow perch and common carp were also found during the last sample by the ND Game and Fish.
- Lake Holmes was previously assessed in 1994-1995 and 2005-2006.

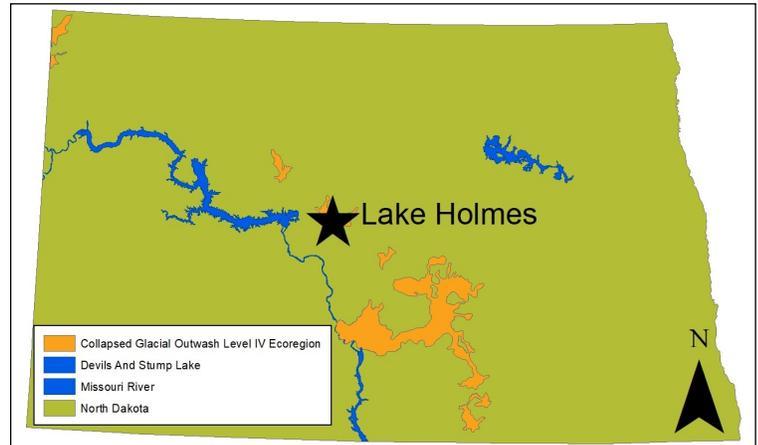


Figure 1. Location of Lake Holmes within the state

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
Agriculture	33.3%	39.7%
Spring Wheat	62.2%	53.8%
Other Hay/Non-Alfalfa	14.8%	3.9%
Soybeans	10.4%	20.8%
Grassland/Pasture	32.9%	32.1%
Open Water	25.0%	13.1%
Developed	5.3%	10.6%
Wetlands	3.4%	4.5%
Forest	0.1%	NA

Temperature and Dissolved Oxygen

- Lake Holmes 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 14.34 degrees Celcius (°C), 0.79°C and 0.10°C in May, July and September, respectively.
- All samples showed most of the lake as well-oxygenated, with only near-bottom concentration during some samples.

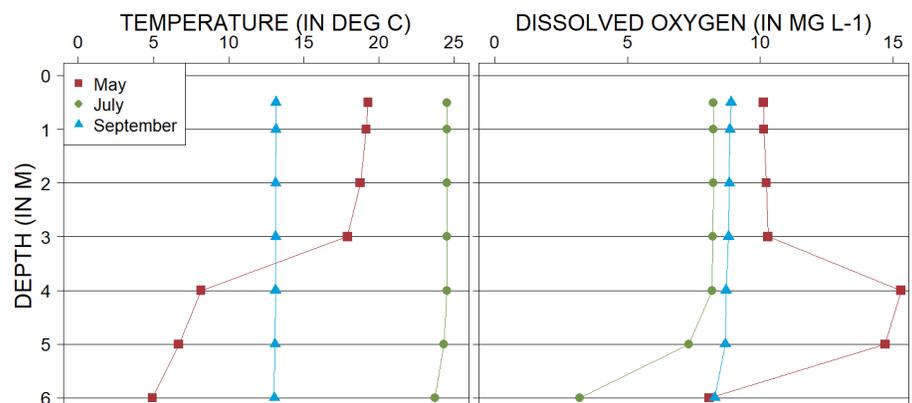


Figure 2. 2018 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L⁻¹)

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.
- Lake Holmes is a eutrophic lake (Figure 3) that has moderate nutrient concentrations and moderate algal growth.
- Current trophic state has improved compared to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Lake Holmes.

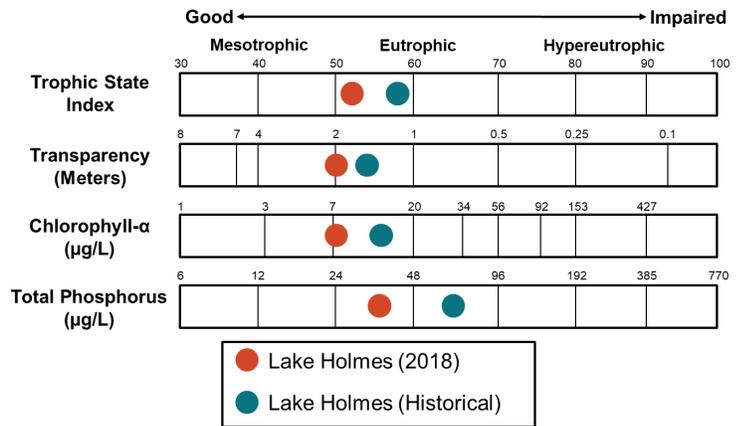


Figure 3. Trophic state indices for 2018 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2018 was greater than the historical median and greater than the median for the Collapsed Glacial Outwash Level IV Ecoregion (hereafter, Glacial Outwash) where Lake Holmes 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 and nitrate plus nitrite were not detected in Lake Holmes in 2018.

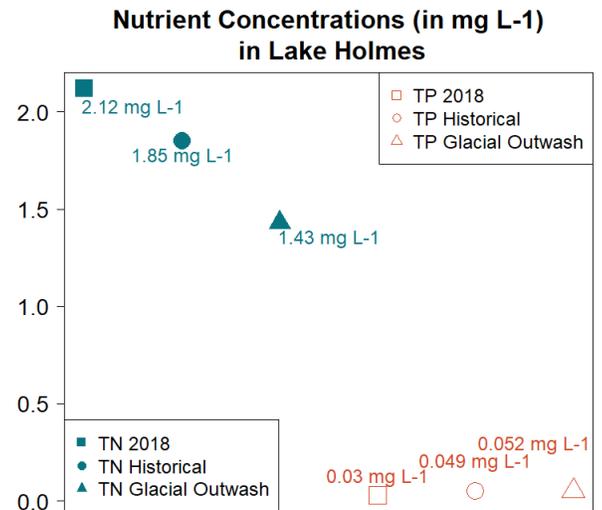


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

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	827 mg L ⁻¹	679 mg L ⁻¹	466 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	749 mg L ⁻¹	604 mg L ⁻¹	464 mg L ⁻¹
Calcium (Ca ²⁺)	22.4 mg L ⁻¹	32.3 mg L ⁻¹	25.3 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	128 mg L ⁻¹	91 mg L ⁻¹	58 mg L ⁻¹
Conductivity	8,100 µS cm ⁻¹	6,260 µS cm ⁻¹	1,770 µS cm ⁻¹
Dissolved Solids	6,720 mg L ⁻¹	4,800 mg L ⁻¹	1,240 mg L ⁻¹
Magnesium (Mg ²⁺)	155 mg L ⁻¹	93.8 mg L ⁻¹	88 mg L ⁻¹
Sodium (Na ⁺)	2,180 mg L ⁻¹	1,360 mg L ⁻¹	163 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	3,610 mg L ⁻¹	2,680 mg L ⁻¹	554 mg L ⁻¹

- Sulfate is the dominant anion in Lake Holmes, while sodium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are greater than the historical median for the lake and greater than the median for the Glacial Outwash.

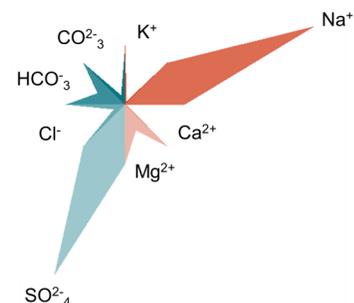


Figure 5. Maucha diagram showing ionic balance based on 2018 data