

February 2019

Boundary Lake

(48.993453 N, -100.20943 W)

Bottineau County

- Boundary Lake is a 426-acre natural lake in northern North Dakota (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/boundarylake2014.pdf>).
- Boundary Lake is accessible by one public, unpaved boat access on the east side of the lake.
- The Boundary Lake watershed is difficult to define considering a portion of the lake is in Canada. There is mostly deciduous forest and open water surrounding the lake (Table 1).
- Boundary Lake is not defined in the state's water quality standards.
- Boundary Lake is managed for walleye, which are stocked annually. The most recent sampling survey by the ND Game and Fish in 2018 found only yellow perch, however.
- Prior to 2015-2016, no water quality sampling had ever been done on Boundary Lake.

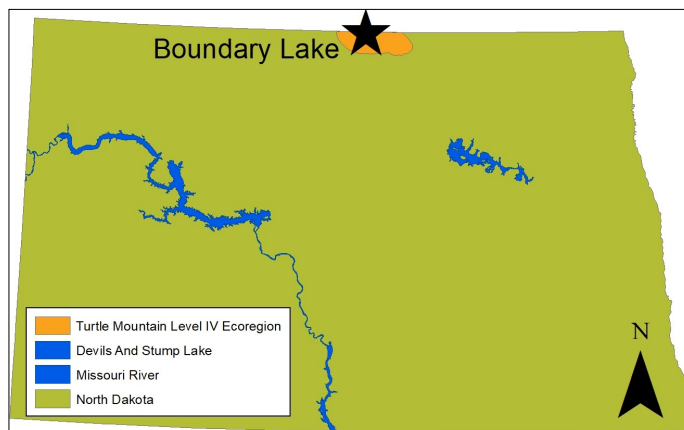


Figure 1. Location of Boundary Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2015). Value listed of crop type represents percentage of total production

Land Cover Type	% within 500 meters
Deciduous Forest	61.1%
Open Water	21.3%
Developed	8.0%
Wetlands	6.9%
Agriculture	2.3%
<i>Canola</i>	52.9%
<i>Sunflowers</i>	17.7%
<i>Other Hay/Non-Alfalfa</i>	11.8%
Grassland/Pasture	0.5%

Temperature and Dissolved Oxygen

- Boundary Lake does stratify in the summer, with warm, well-oxygenated water at the top of the water column, and cold, low-oxygen water near the bottom.
- Stratification was observed in July of 2016, with a temperature change of 3.93 degrees Celsius (°C) (Figure 2).
- All samples showed sharp declines in dissolved oxygen corresponding with thermal stratification (or even weak stratification).

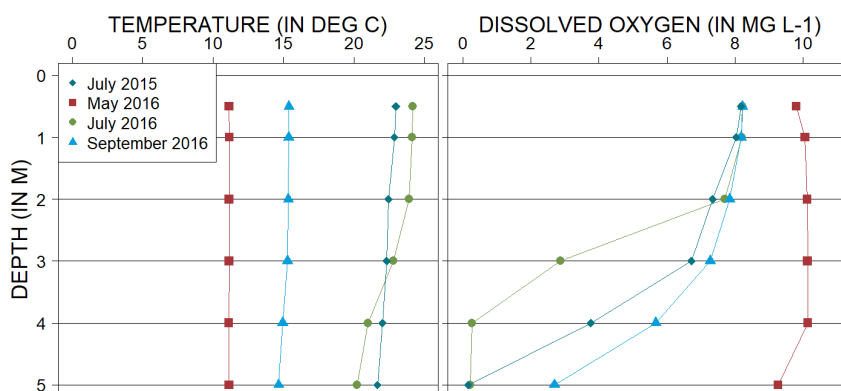


Figure 2. 2015 and 2016 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L⁻¹)

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.
- Boundary Lake is a eutrophic lake (Figure 3).
- There are no historical data to compare trophic state over time.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Boundary Lake.

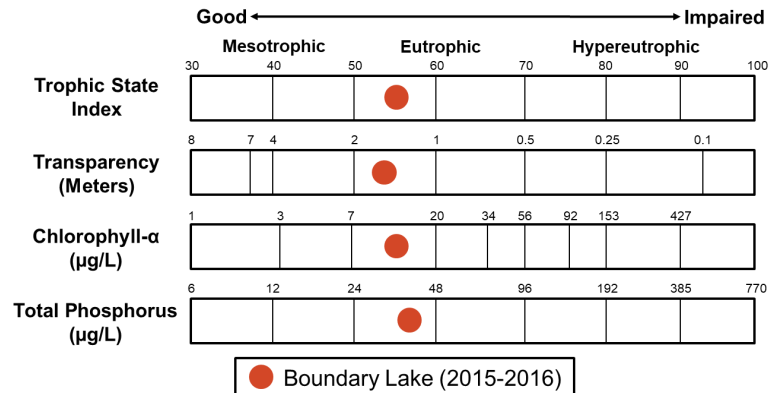


Figure 3. Trophic state indices for 2015 and 2016

Nutrients

- Median concentration of total nitrogen (TN) was lower in 2015-2016 compared to the median for the Turtle Mountains Level IV Ecoregion (Figure 1; hereafter, Turtle Mountains) where Boundary Lake is located (Figure 4).
- Median concentration of dissolved TN was similar to TN.
- Median TP concentration in 2015-2016 was greater than the median for the Turtle Mountains (Figure 4).
- Median concentration of dissolved phosphorus were similar to TP.
- Ammonia and nitrate plus nitrite were rarely above detection limits in Boundary Lake in 2015-2016.

Nutrient Concentrations (in mg L⁻¹) in Boundary Lake

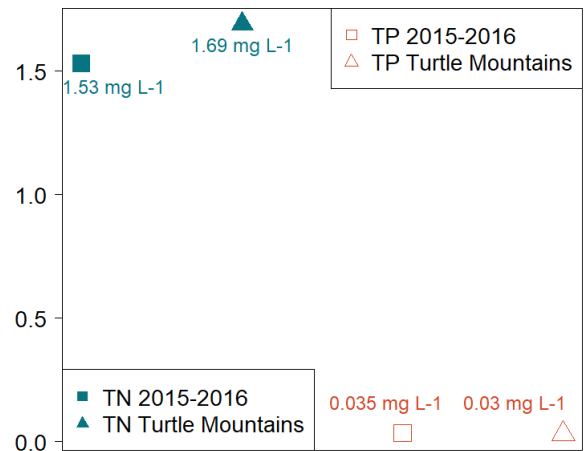


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians.

Water Chemistry

Table 2. Median concentrations of selected constituents for 2015 and historical samples and from all Turtle Mountain natural lakes.

Measure	2015-2016 Median	Ecoregion Median
Alkalinity	343 mg L ⁻¹	290 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	367 mg L ⁻¹	325 mg L ⁻¹
Calcium (Ca ²⁺)	30.0 mg L ⁻¹	32.4 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	25 mg L ⁻¹	12 mg L ⁻¹
Conductivity	599 µS cm ⁻¹	685 µS cm ⁻¹
Dissolved Solids	345 mg L ⁻¹	382 mg L ⁻¹
Magnesium (Mg ²⁺)	62.9 mg L ⁻¹	61.9 mg L ⁻¹
Sodium (Na ⁺)	12.4 mg L ⁻¹	8.9 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	5.5 mg L ⁻¹	60 mg L ⁻¹

- Bicarbonate is the dominant anion in Boundary Lake, while magnesium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are greater than the Ecoregion median.

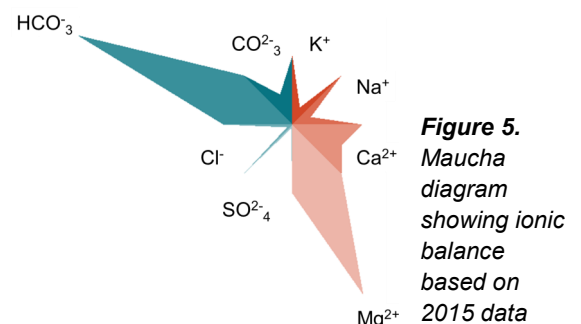


Figure 5. Maucha diagram showing ionic balance based on 2015 data