

February 2019

Gravel Lake

(48.95667 N, -99.83436 W)

Rolette County

- Gravel Lake is a small, natural lake in northern North Dakota (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/gravel2004.pdf>).
- Gravel Lake is accessible by one public boat ramp on the west side of the lake.
- The Gravel Lake watershed is about 600 acres of mostly deciduous forest and open water. The only crops are alfalfa and other hay/non-alfalfa (Table 1).
- Gravel Lake 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.”
- Historically, Gravel Lake has been managed for northern pike, but walleye fingerlings have been stocked in recent years. The most recent sampling survey by the ND Game and Fish found northern pike, yellow perch and bluegill, with most of the latter two being small fish.
- Gravel Lake was previously sampled in 1995-1996, as well as 2012 and 2017 for the National Lakes Assessment.

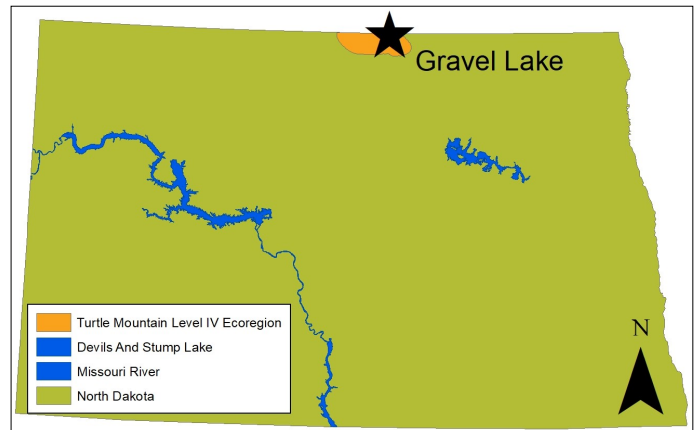


Figure 1. Location of Gravel Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2014). Value listed of crop type represents percentage of total production

Land Cover Type	% in Watershed	% within 500 meters
Deciduous Forest	51.9%	59.7%
Open Water	34.2%	25.9%
Grassland/Pasture	4.9%	2.8%
Agriculture	4.8%	2.5%
Other Hay/Non-Alfalfa	61.3%	75.4%
Alfalfa	38.7%	24.6%
Wetlands	0.8%	0.4%
Developed	0.1%	0.3%

Temperature and Dissolved Oxygen

- Gravel Lake commonly stratifies 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 May and July of 2015, with a temperature changes of 3.46 degrees Celsius (°C) and 5.67°C, respectively (Figure 2).
- All samples showed the lake as well-oxygenated, except near the bottom during thermal stratification.

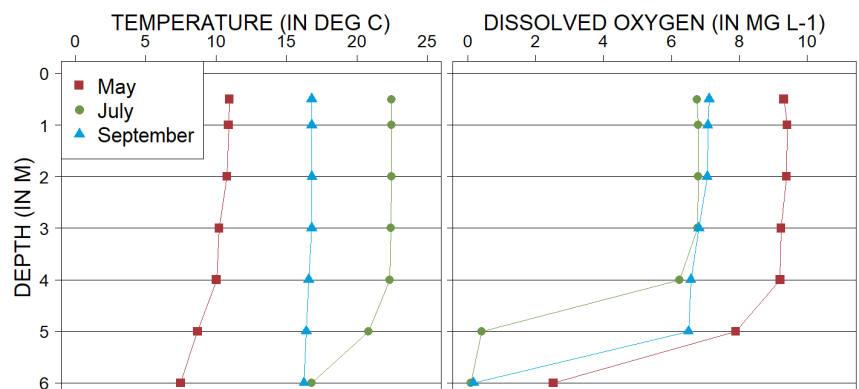


Figure 2. 2015 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L⁻¹)

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.
- Gravel Lake is a mesotrophic lake (Figure 3) that has low nutrient concentrations and low algal growth.
- Trophic state is relatively similar to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Gravel Lake.

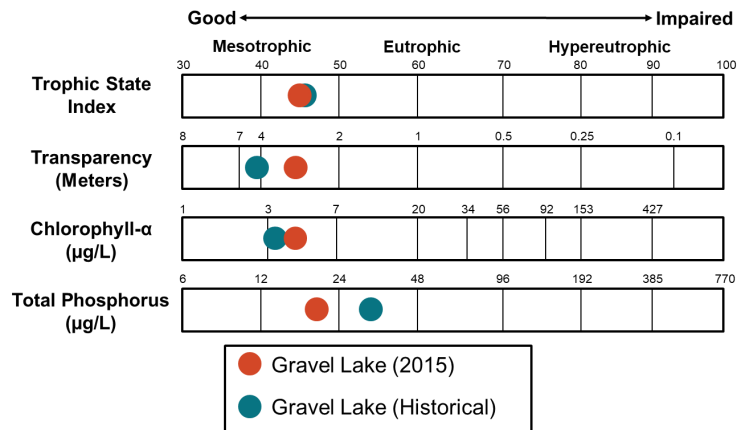


Figure 3. Trophic state indices for 2015 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) was lower in 2015 compared to the historical median and the median for the Turtle Mountains Level IV Ecoregion (Figure 1; hereafter, Turtle Mountains) where Gravel Lake is located (Figure 4).
- Median concentration of dissolved TN was similar to TN.
- Median TP concentration in 2015 was less than historical concentrations and 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 Gravel Lake in 2015 and 2017.

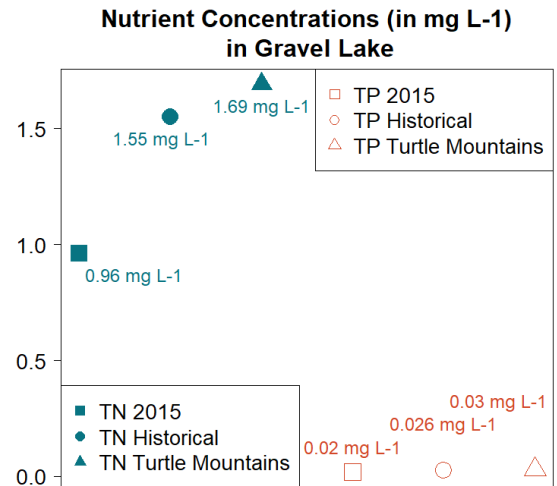


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians. Median concentration from 2015 includes the one sample taken in 2017.

Water Chemistry

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

Measure	2015 Median ¹	Historical Median	Ecoregion Median
Alkalinity	257 mg L ⁻¹	310 mg L ⁻¹	290 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	294 mg L ⁻¹	345 mg L ⁻¹	325 mg L ⁻¹
Calcium (Ca ²⁺)	31.1 mg L ⁻¹	29.0 mg L ⁻¹	32.4 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	10.5 mg L ⁻¹	8.5 mg L ⁻¹	12 mg L ⁻¹
Conductivity	562 µS cm ⁻¹	776 µS cm ⁻¹	685 µS cm ⁻¹
Dissolved Solids	322 mg L ⁻¹	444 mg L ⁻¹	382 mg L ⁻¹
Magnesium (Mg ²⁺)	52.3 mg L ⁻¹	78.6 mg L ⁻¹	61.9 mg L ⁻¹
Sodium (Na ⁺)	9.4 mg L ⁻¹	13.5 mg L ⁻¹	8.9 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	58.1 mg L ⁻¹	123 mg L ⁻¹	60 mg L ⁻¹

¹Includes one sample taken in 2017

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

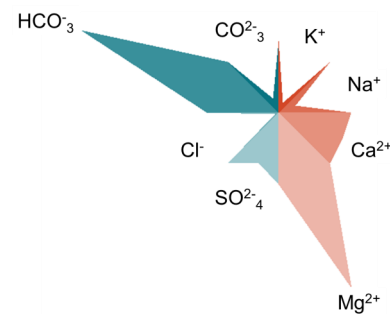


Figure 5. Maucha diagram showing ionic balance based on 2015 data