

April 2019

Coal Lake

(47.44164 N, -101.07805 W)

Mclean County

- Coal Lake is a large natural lake in central North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/coallake2016.pdf>).
- There is one primitive boat/winter access on the south side of Coal Lake, with an additional winter access on the north side off of Highway 200.
- The Coal Lake watershed is about 9,000 acres of mostly grassland/pasture and agricultural land. The most common crops grown are spring wheat, alfalfa and non-alfalfa hay (Table 1).
- Coal Lake is not defined in the state water quality standards.
- Coal Lake has been managed for walleye, yellow perch, and black crappie, though Coal Lake has experienced winter kills in recent years. Only walleye were found during the last sample by the ND Game and Fish.
- Coal Lake has no historical data.

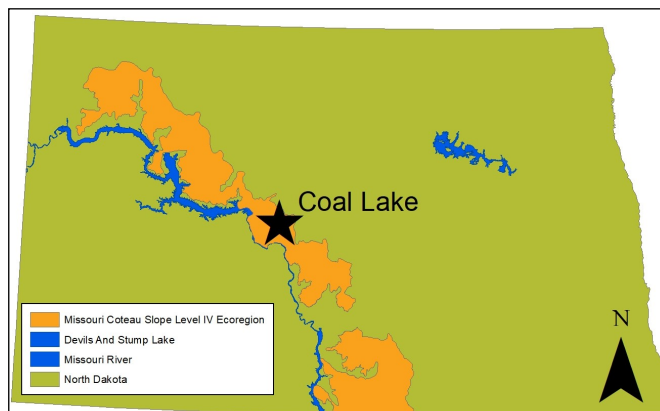


Figure 1. Location of Coal Lake within the state

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
Agriculture	38.1%	20.6%
Spring Wheat	37.5%	51.5%
Other Hay/Non-Alfalfa	19.9%	40.8%
Alfalfa	11.5%	5.1%
Grassland/Pasture	29.6%	60.9%
Barren	13.2%	NA
Open Water	6.4%	1.3%
Developed	5.8%	5.0%
Wetlands	4.7%	4.6%
Forest	2.3%	7.7%

Temperature and Dissolved Oxygen

- Coal 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.
- There was thermal stratification in July 2015. Temperature change in the water column was 0.38 degrees Celsius (°C), 2.71°C and 0.36°C in May, July and October, respectively.
- Profiles showed the lake as oxygen-depleted during times of thermal stratification, or even weak stratification (September).

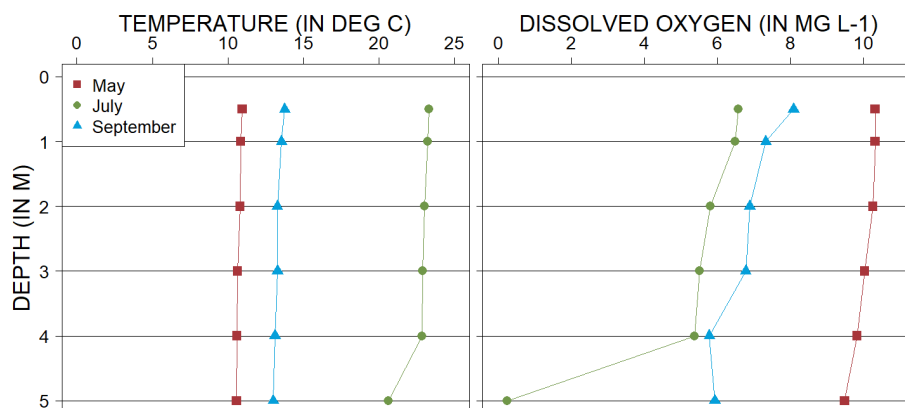


Figure 2. 2015 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L^{-1})

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.
- Coal Lake is a hypereutrophic lake (Figure 3) that has high nutrient concentrations and dense algal growth.
- There are no historical indices for comparison.
- Coal Lake experiences persistent (and occasionally harmful) cyanobacteria blooms during the summer.

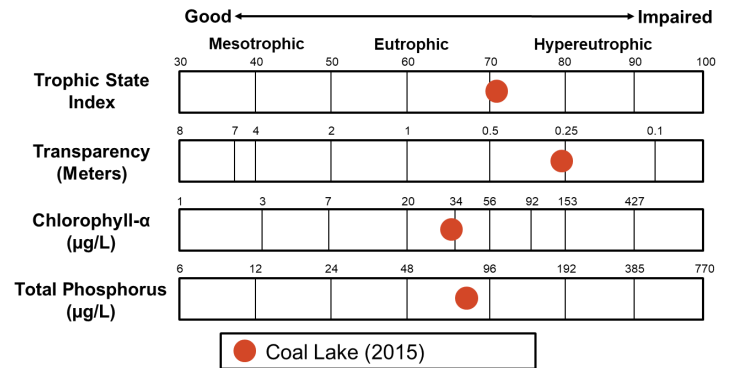


Figure 3. Trophic state indices for 2015 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2015 was less than the median for the Missouri Coteau Slope Level IV Ecoregion (hereafter, Coteau Slope) where Coal Lake is located (Figure 4).
- Median concentration of dissolved TN was slightly less than TN.
- Median TP concentration in 2015 was less than the median for the Coteau Slope (Figure 4).
- Median concentration of dissolved phosphorus was much less than TP.
- Ammonia was detected at a low concentrations during one samples at Coal Lake in 2015, while there were no detections of nitrate plus nitrite.

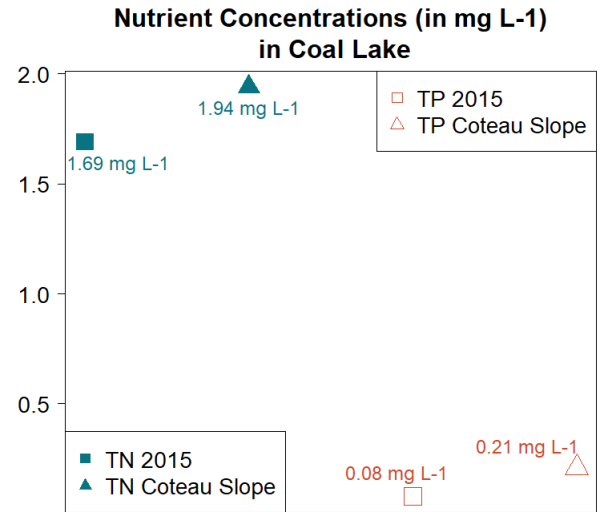


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2015 and historical samples and from all Coteau Slope lakes.

Measure	2015 Median	Ecoregion Median
Alkalinity	280 mg L ⁻¹	380 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	314 mg L ⁻¹	408 mg L ⁻¹
Calcium (Ca ²⁺)	100 mg L ⁻¹	38.8 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	14 mg L ⁻¹	28.5 mg L ⁻¹
Conductivity	1,530 $\mu\text{S cm}^{-1}$	1,405 $\mu\text{S cm}^{-1}$
Dissolved Solids	1,090 mg L ⁻¹	961 mg L ⁻¹
Magnesium (Mg ²⁺)	111 mg L ⁻¹	74.8 mg L ⁻¹
Sodium (Na ⁺)	84.9 mg L ⁻¹	155 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	588 mg L ⁻¹	385 mg L ⁻¹

- Sulfate is the dominant anion in Coal Lake, while magnesium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are similar to the median for the Coteau Slope.

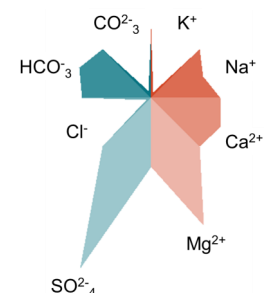


Figure 5. Maucha diagram showing ionic balance based on 2015 data