

March 2019

Rudolph Lake

(47.17167 N, -100.30164 W)

Emmons County

- Rudolph Lake is a small, 106-acre lake in south-central North Dakota (Figure 1).
- Rudolph Lake is accessible through an easement on the west side of the lake.
- The Rudolph Lake watershed is about 22,000 acres of mostly grassland/pasture and agricultural land. The most common crops grown are non-alfalfa hay, soybeans and corn (Table 1).
- Rudolph Lake is a Class III fishery, which means it is “capable of supporting natural reproduction of warm water fishes (e.g., largemouth bass and bluegill) and associated aquatic biota.”
- The lake is no longer managed by the ND Game and Fish (listed as an inactive fishery), but was previously managed for walleye and yellow perch.
- Rudolph Lake was previously assessed in 2010.

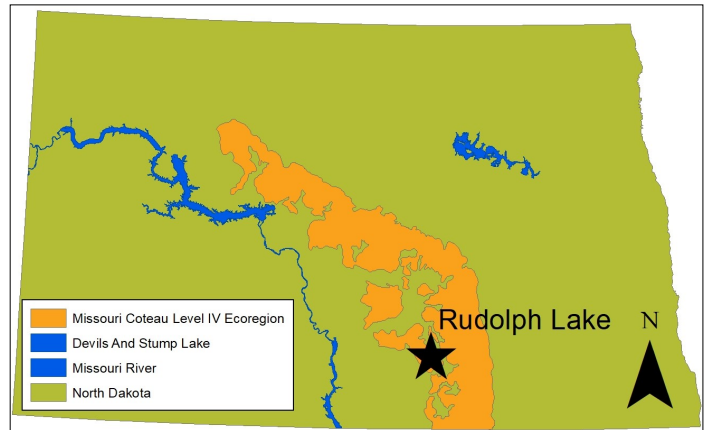


Figure 1. Location of Rudolph Lake within the state

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	% in Watershed	% within 500 meters
Grassland/Pasture	63.7%	65.9%
Agriculture	21.8%	21.8%
Other Hay/Non-Alfalfa	32.5%	43.0%
Soybeans	29.4%	17.6%
Corn	12.6%	1.1%
Open Water	9.6%	9.6%
Developed	2.4%	NA
Wetlands	2.3%	2.6%
Forest	< 0.1%	< 0.1%

Temperature and Dissolved Oxygen

- Rudolph Lake rarely stratifies in the summer, with the majority of the water column typically well-oxygenated.
- There was no thermal stratification recorded in 2016. Temperature change in the water column was 0.33 degrees Celsius (°C), 1.00°C and 0.36°C in May, July and September, respectively (Figure 2).
- All samples in 2016 showed the lake as well-oxygenated, except near the bottom in all samples.

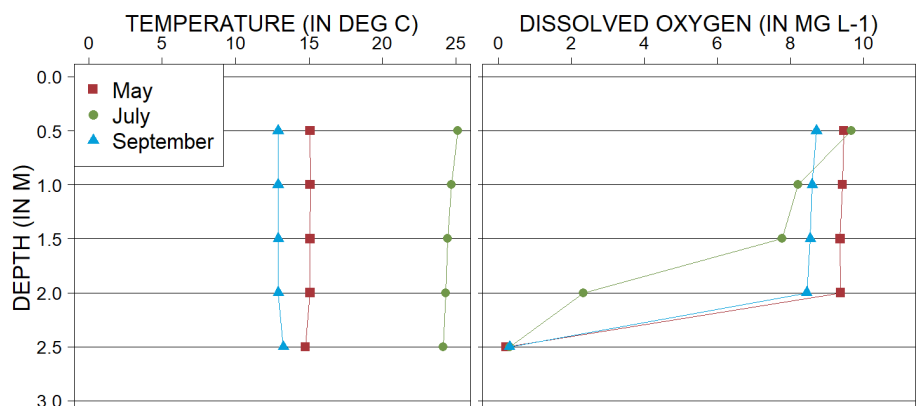


Figure 2. 2016 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ($mg L^{-1}$)

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.
- Rudolph Lake is a eutrophic lake (Figure 3) that has relatively high nutrient concentrations with moderate algal growth but dense plant growth.
- Trophic state is similar to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Rudolph Lake.

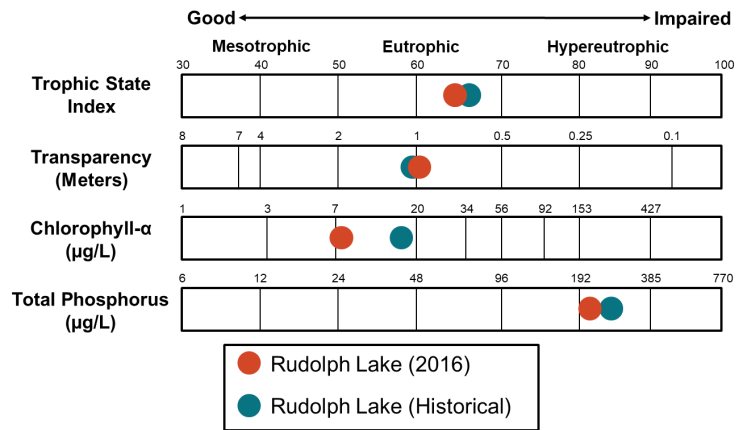


Figure 3. Trophic state indices for 2016 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2016 was less than the historical median but greater than the median for the Missouri Coteau Level IV Ecoregion (hereafter, Missouri Coteau) where Rudolph Lake is located (Figure 4).
- Median concentration of dissolved TN was similar TN.
- Median TP concentration in 2016 was greater than the historical concentration and greater than the median for the Missouri Coteau (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia was detected in low concentrations for all samples in 2016 at Rudolph Lake, while nitrate plus nitrite was only detected once.

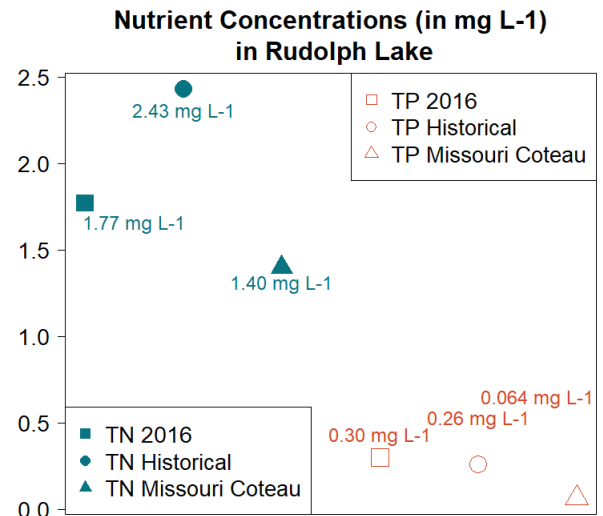


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2016 and historical samples and from all Missouri Coteau lakes.

Measure	2016 Median	Historical Median	Ecoregion Median
Alkalinity	397 mg L ⁻¹	294 mg L ⁻¹	274 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	435 mg L ⁻¹	268 mg L ⁻¹	289 mg L ⁻¹
Calcium (Ca ²⁺)	69.8 mg L ⁻¹	52.8 mg L ⁻¹	39.8 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	32 mg L ⁻¹	48 mg L ⁻¹	21 mg L ⁻¹
Conductivity	2,380 µS cm ⁻¹	1,580 µS cm ⁻¹	1,010 µS cm ⁻¹
Dissolved Solids	1,730 mg L ⁻¹	1,100 mg L ⁻¹	642 mg L ⁻¹
Magnesium (Mg ²⁺)	132 mg L ⁻¹	79.3 mg L ⁻¹	72.4 mg L ⁻¹
Sodium (Na ⁺)	307 mg L ⁻¹	198 mg L ⁻¹	62 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	909 mg L ⁻¹	548 mg L ⁻¹	239 mg L ⁻¹

- Sulfate is the dominant anion in Rudolph Lake, while sodium is the dominant cation (with magnesium being relatively high) (Figure 5).
- Median concentrations of most cations and anions are greater than the historical median for the lake and median concentrations for the Missouri Coteau.

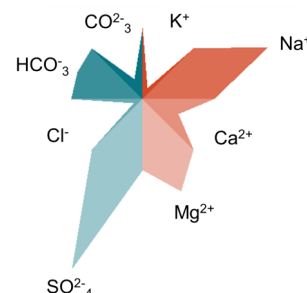


Figure 5. Maucha diagram showing ionic balance based on 2016 data