

November 2020

Red Willow Lake

(47.64576 N, -98.37293 W)

Griggs County

- Red Willow Lake is a natural lake in east-central North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/redwillow2004.pdf>).
- There is one public, paved boat ramp on Red Willow Lake on the southeast side of the lake.
- The Red Willow Lake watershed is about 3,400 acres of mostly grassland/pasture and agriculture (Table 1). Agricultural production in the watershed is dominated by other hay/non-alfalfa, spring wheat and oats.
- Red Willow Lake is a Class II, cool-water fishery, which are “capable of supporting natural reproduction and growth of cool water fishes (e.g., northern pike and walleye) and associated aquatic biota.”
- Red Willow Lake is managed for walleye, with fingerlings stocked annually. Walleye, northern pike, bluegill and yellow perch were captured during the last sample by the ND Game and Fish. Muskellunge are also present in the lake.
- Red Willow Lake was previously assessed in 1992-1993 and 2004-2005.

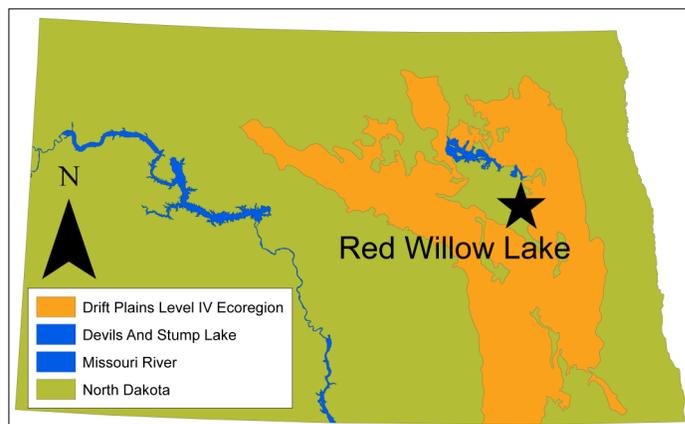


Figure 1. Location of Red Willow Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2019). Value listed of crop type represents percentage of total production

Land Cover Type	% in Watershed	% within 500 meters
Grassland/Pasture	64.5%	49.3%
Agriculture	13.3%	1.6%
Spring Wheat	40.1%	3.8%
Oats	16.5%	NA
Other Hay/Non-Alfalfa	16.5%	79.2%
Wetlands	7.5%	22.8%
Forest	6.1%	16.2%
Open Water	5.3%	3.2%
Developed	3.4%	6.8%
Shrubland	< 0.1%	NA

Temperature and Dissolved Oxygen

- Red Willow Lake can stratify in the open-water season.
- Thermal stratification was not recorded 2020. Top-to-bottom temperature changes of 1.3°C, 1.4°C, 3.1°C and 0.0°C were recorded in May, June, July and October, respectively.
- Dissolved oxygen concentrations were relatively high throughout the water column during all samples, but did decline sharply with weak stratification in July.

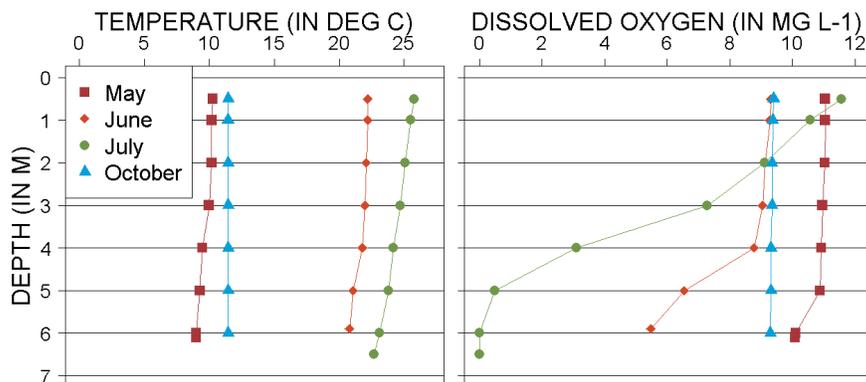


Figure 2. 2020 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ($mg\ L^{-1}$)

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.
- Red Willow Lake is a mesotrophic lake (Figure 3) that has moderate nutrient concentrations and moderate algal growth.
- Current trophic state is improved compared to historical data.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Red Willow Lake as of 2020.

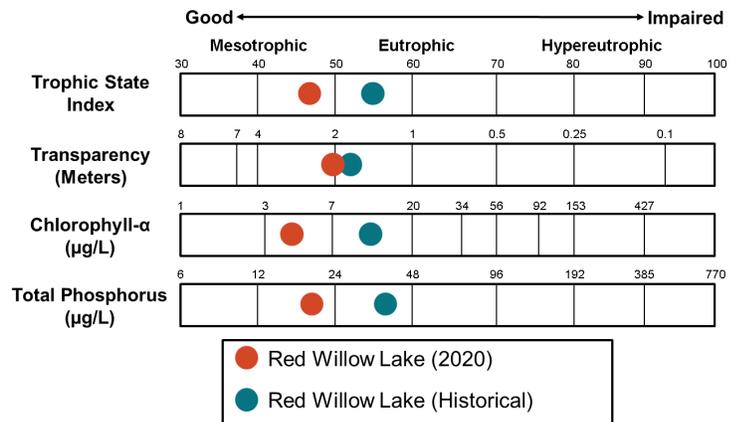


Figure 3. Trophic state indices for 2020 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2020 was less than the historical median for the lake and similar to the median for natural lakes in the Drift Plains Level IV Ecoregion (hereafter, Ecoregion) where Red Willow Lake is located (Figure 4).
- Median concentration of dissolved TN was slightly less than TN.
- Median total phosphorus (TP) concentration in 2020 was less than the median for the lake and less than the median for the Ecoregion (Figure 4).
- Median concentration of dissolved phosphorus was similar to TP.
- Neither ammonia nor nitrate-plus-nitrite were detected at Red Willow Lake in 2020.

Nutrient Concentrations (in mg L⁻¹) in Red Willow Lake

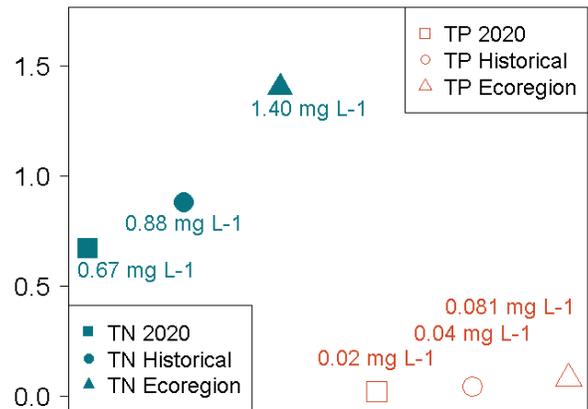


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2020 and historical samples and from all Ecoregion natural lakes.

Measure	2020 Median	Historical Median	Ecoregion Median
Alkalinity	234.5 mg L ⁻¹	203 mg L ⁻¹	249 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	275 mg L ⁻¹	227.5 mg L ⁻¹	283.5 mg L ⁻¹
Calcium (Ca ²⁺)	43.9 mg L ⁻¹	31.5 mg L ⁻¹	47.8 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	5.5 mg L ⁻¹	13 mg L ⁻¹	17.5 mg L ⁻¹
Conductivity	513 µS cm ⁻¹	520 µS cm ⁻¹	1,395 µS cm ⁻¹
Dissolved Solids	293.5 mg L ⁻¹	300.5 mg L ⁻¹	1,070 mg L ⁻¹
Magnesium (Mg ²⁺)	34.3 mg L ⁻¹	36.2 mg L ⁻¹	88.4 mg L ⁻¹
Sodium (Na ⁺)	11.2 mg L ⁻¹	13.0 mg L ⁻¹	117 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	49.4 mg L ⁻¹	54.7 mg L ⁻¹	587.5 mg L ⁻¹

- Bicarbonate is the dominant anion in Red Willow Lake, while magnesium and calcium are co-dominant cations (Figure 5).
- Median concentrations of most cations and anions are similar to the historical median for the lake but less than the median for the Ecoregion.

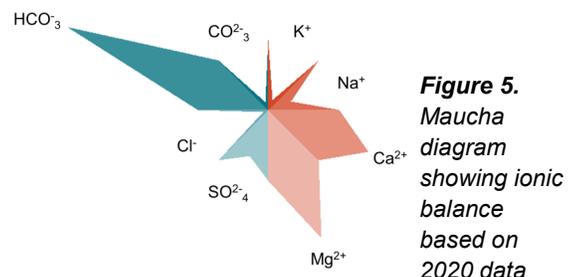


Figure 5. Maucha diagram showing ionic balance based on 2020 data