

December 2021

Kalmbach Lake

(46.505669 N, -98.990459 W)

Lamoure County

- Kalmbach Lake is a small, natural lake in southeastern North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/kalmbach2005.pdf>).
- There is one boat ramp on Kalmbach Lake on the northeast side of the lake.
- The Kalmbach Lake watershed is about 9,000 acres of mostly agriculture. The most common crops grown are soybeans, corn and fallow/idle cropland (Table 1).
- Kalmbach Lake is a Class III fishery, which are “capable of supporting natural reproduction and growth of warm water fishes (e.g., largemouth bass and bluegill) and associated aquatic biota.”
- Kalmbach Lake is managed by the NDGF as a northern pike fishery, with fingerlings stocked most years. Northern pike were the only species captured in the last sample by the NDGF in 2020.
- Kalmbach Lake was previously assessed in 2005 -2006 by the NDDEQ.

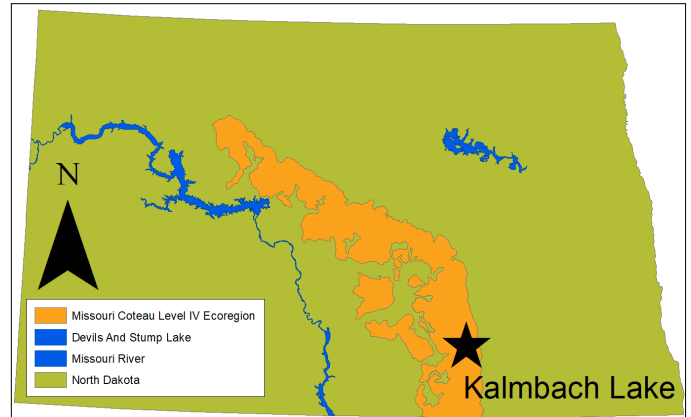


Figure 1. Location of Kalmbach Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2020). Value listed of crop type represents percentage of total production

Land Cover Type	% in Watershed	% within 500 meters
Agriculture	55.8%	28.1%
Soybeans	51.7%	22.7%
Fallow/Idle Cropland	31.7%	58.9%
Spring Wheat	6.9%	0.1%
Grassland/Pasture	20.1%	28.1%
Open Water	13.2%	25.4%
Wetlands	7.4%	13.6%
Developed	3.0%	4.4%
Forest	0.3%	0.2%
Shrubland	0.2%	0.2%

Temperature and Dissolved Oxygen

- Kalmbach Lake rarely stratifies in the summer due to its very shallow depth.
- There was no thermal stratification recorded in 2021. Temperature change in the water column was 0.0 degrees Celsius (°C), 0.9°C, 0.0°C, and 0.0°C in May, June, July and October, respectively.
- Most dissolved oxygen concentrations were relatively high, though there were low readings in June and July.

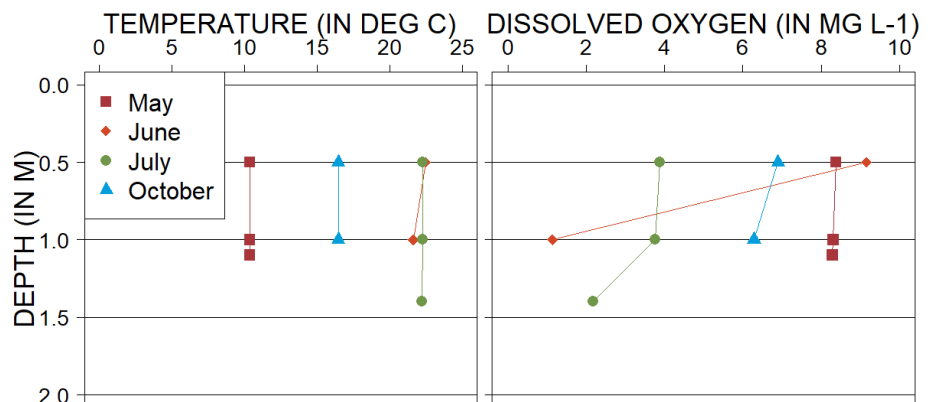


Figure 2. 2021 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L⁻¹)

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.
- Kalmbach Lake is a hypereutrophic natural lake (Figure 3) that has high nutrient concentrations, dense algal growth, and low transparency.
- Trophic state in 2021 is worse compared to historical indices.
- Kalmbach Lake has not had any confirmed **harmful** algal (cyanobacteria) blooms, though there was dense cyanobacteria growth in 2021.

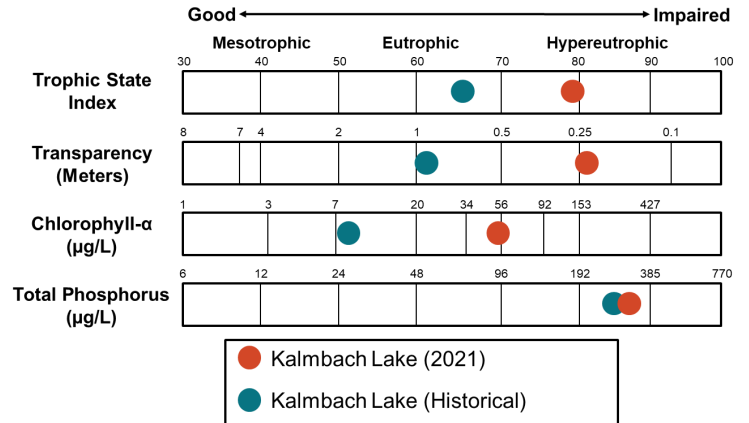


Figure 3. Trophic state indices for 2021 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) at Kalmbach Lake in 2021 was much greater than the historical median for the lake and the median for natural lakes in the Missouri Coteau Level IV Ecoregion (hereafter, Ecoregion) (Figure 4).
- Median TP concentration in 2021 was greater than the median for the lake and much greater than the median for the Ecoregion (Figure 4).
- Median concentrations of dissolved nutrients were much less than concentrations of total nutrients.
- Ammonia and nitrate-plus-nitrite were only detected during a couple samples in 2021, but were found at relatively low concentrations.

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

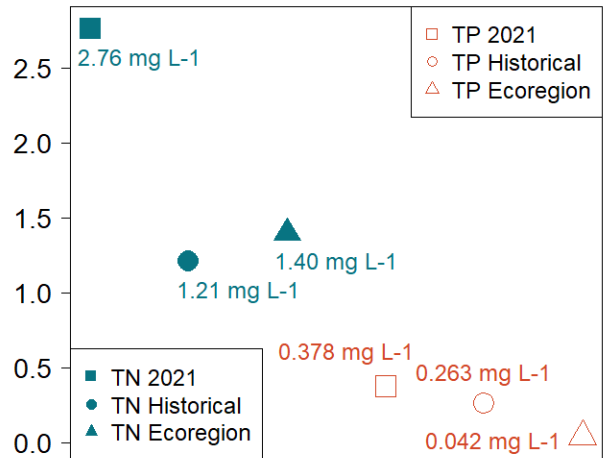


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2021 and historical samples and from all Ecoregion natural lakes.

Measure	2021 Median	Historical Median	Ecoregion Median
Alkalinity	323.5 mg L ⁻¹	209 mg L ⁻¹	318.5 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	363 mg L ⁻¹	252.5 mg L ⁻¹	333.5 mg L ⁻¹
Calcium (Ca ²⁺)	108 mg L ⁻¹	58.3 mg L ⁻¹	41.2 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	22 mg L ⁻¹	3 mg L ⁻¹	26.5 mg L ⁻¹
Conductivity	2,595 µS cm ⁻¹	1,030 µS cm ⁻¹	1,340 µS cm ⁻¹
Dissolved Solids	2,025 mg L ⁻¹	679 mg L ⁻¹	877 mg L ⁻¹
Magnesium (Mg ²⁺)	210 mg L ⁻¹	63.1 mg L ⁻¹	91.3 mg L ⁻¹
Sodium (Na ⁺)	233 mg L ⁻¹	65.4 mg L ⁻¹	127 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	1,215 mg L ⁻¹	331 mg L ⁻¹	391.5 mg L ⁻¹

- Sulfate is the dominant anion in Kalmbach Lake, while magnesium is the dominant cations (Figure 5).
- Median concentrations of most cations and anions are much greater than the historical median for the lake and much greater than the median for the Ecoregion.

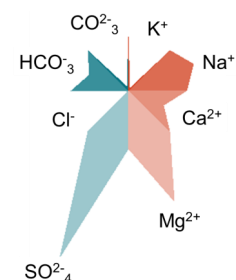


Figure 5. Maucha diagram showing ionic balance based on 2021 data