

October 2019

Armourdale Dam

(48.88328 N, -99.41875 W)

Towner County

- Armourdale Dam is a reservoir in northern North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/armourdale2003.pdf>).
- There is one public boat ramp on Armourdale Dam on the east side of the lake.
- The Armourdale Dam watershed is about 11,000 acres of mostly agricultural land. The most common crops grown are spring wheat, canola and soybeans (Table 1).
- Armourdale Dam 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.”
- Armourdale Dam is managed for walleye and yellow perch, with fingerlings of the former stocked annually. Walleye, yellow perch and northern pike were found during the last sample by the ND Game and Fish.
- Armourdale Dam was previously assessed in 1991-1992.

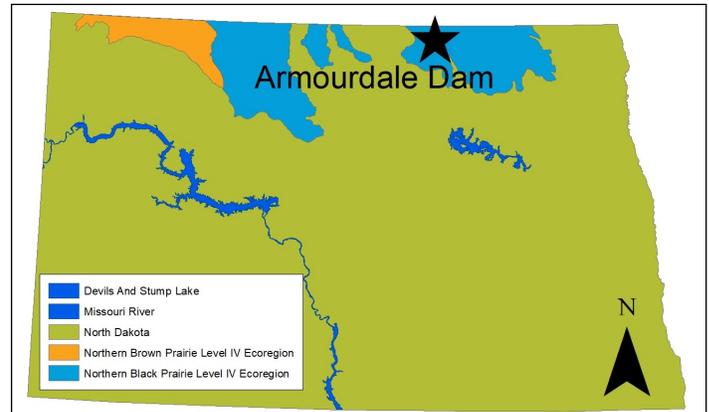


Figure 1. Location of Armourdale Dam within the state

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
Agriculture	79.2%	72.6%
Spring Wheat	39.6%	36.1%
Canola	22.1%	20.1%
Soybeans	13.6%	10.7%
Grassland/Pasture	8.8%	16.6%
Wetlands	6.8%	5.6%
Developed	3.3%	3.7%
Open Water	1.5%	1.3%
Forest	0.5%	< 0.1%

Temperature and Dissolved Oxygen

- Armourdale Dam regularly stratifies 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 May and July 2016. Temperature change in the water column was 3.21 degrees Celsius (°C), 5.08°C and 0.66°C in May, July and September, respectively.
- Dissolved oxygen concentrations were low in Armourdale Dam in July with thermal stratification.

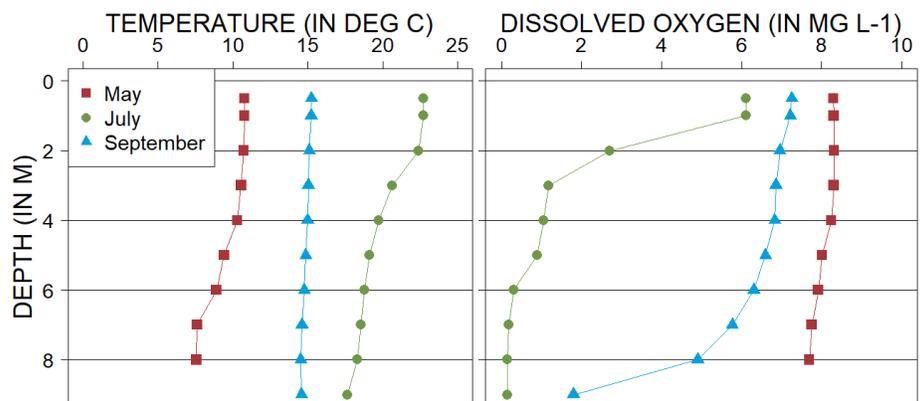


Figure 2. 2016 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L⁻¹)

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.
- Armourdale Dam is a eutrophic reservoir (Figure 3) that has high nutrient concentrations but moderate algal growth.
- Current trophic state has greatly improved compared to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Armourdale Dam.

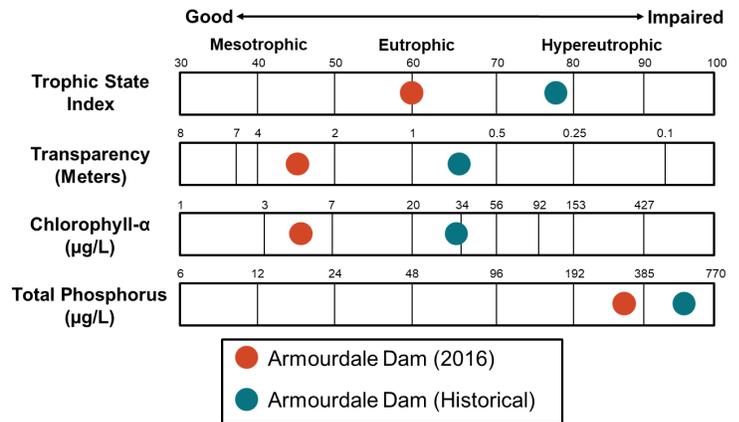


Figure 3. Trophic state indices for 2016 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) in 2016 was less than the historical median for the lake and less than the median for the combined Dark Prairie Level IV Ecoregions (hereafter, Ecoregion) where Armourdale Dam is located (Figure 4).
- Median concentration of dissolved TN was similar to TN.
- Median TP concentration in 2016 was less than the median for the lake but greater than the median for the Ecoregion (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia was detected in all samples at Armourdale Dam in 2016, while there were two detections of nitrate plus nitrite.

Nutrient Concentrations (in mg L⁻¹) in Armourdale Dam

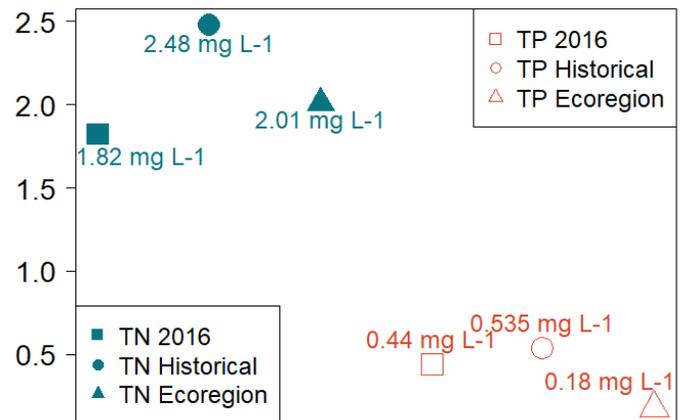


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2016 and historical samples and from all Ecoregion reservoirs.

Measure	2016 Median	Historical Median	Ecoregion Median
Alkalinity	249 mg L ⁻¹	241 mg L ⁻¹	284 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	299 mg L ⁻¹	268 mg L ⁻¹	322.5 mg L ⁻¹
Calcium (Ca ²⁺)	80.1 mg L ⁻¹	65.2 mg L ⁻¹	55.9 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	< 1 mg L ⁻¹	28 mg L ⁻¹	7 mg L ⁻¹
Conductivity	937 µS cm ⁻¹	675 µS cm ⁻¹	1,084 µS cm ⁻¹
Dissolved Solids	618 mg L ⁻¹	411 mg L ⁻¹	698.5 mg L ⁻¹
Magnesium (Mg ²⁺)	58.7 mg L ⁻¹	43.3 mg L ⁻¹	48.8 mg L ⁻¹
Sodium (Na ⁺)	44.4 mg L ⁻¹	26.1 mg L ⁻¹	112 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	273 mg L ⁻¹	118 mg L ⁻¹	292.5 mg L ⁻¹

- Sulfate and bicarbonate are co-dominant anions in Armourdale Dam, while magnesium and calcium are co-dominant cations (Figure 5).
- Median concentrations of most cations and anions are much greater than the historical median for the lake and greater than the median for the Ecoregion.

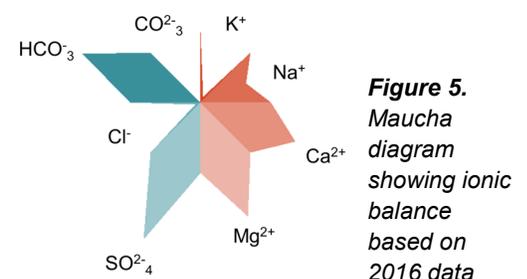


Figure 5. Maucha diagram showing ionic balance based on 2016 data