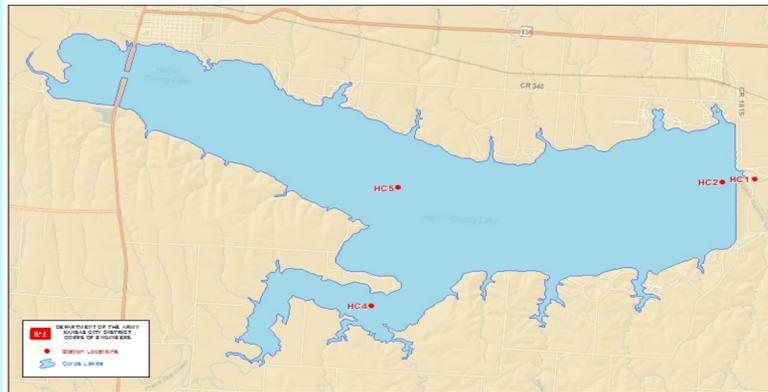


Harlan County Lake Water Quality Data 2010-2019



Harlan County Lake

- Built on Republican River at RM 232 reaching full pool in 1951.
- **Watershed** = 7,169 square miles / 4,588,160 Surface Acres (SA)
- **Capacity:**
 - Flood Control: 500,000 Acre-feet (AF) / 23,431 SA
 - Multipurpose: 150,000 AF / 13,305 SA / 54 miles of shoreline
 - Avg. annual inflow (2010-2019)=151,190 AF; 2019 inflow=403,361 AF
- **Operating project purposes:** flood control, irrigation, recreation, fish and wildlife
- **Water Quality** results were influenced by increased inflows in 2019. Harlan County Lake exceeded Nebraska Department of Environmental Quality (NEDEQ) nutrient criteria and included a period of low dissolved oxygen in July which could stress aquatic life. Water quality at Harlan County Lake improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams and upper lake to the dam.

Nutrient Enrichment

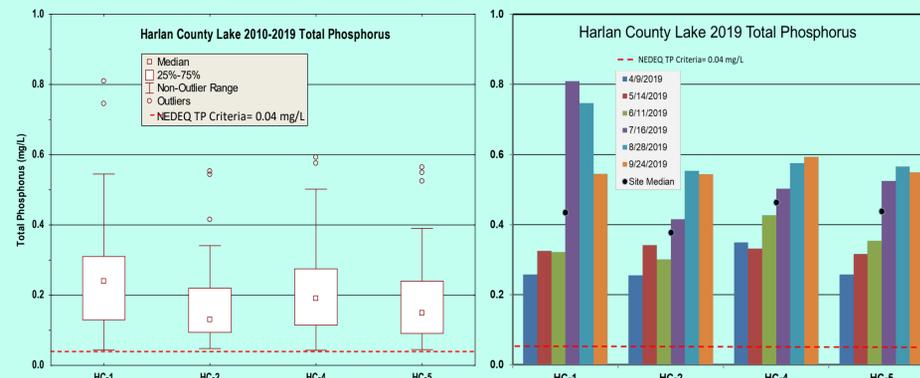
Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and are the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. Eutrophication can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen affecting fish survival, and lead to taste and odor issues in drinking water. Harlan County Lake is listed in the 2018 Nebraska 303(d) list of impaired waters due to excessive total phosphorus and total nitrogen concentrations. Nebraska Department of Environmental Quality (NEDEQ) and U.S. Environmental Protection Agency (EPA) are working with water quality partners to reduce nutrient inflow into Harlan County Lake in effort to improve water quality. In 2019, Harlan County Lake ranked above average among District Lakes for average total phosphorus (0.18 mg/L) and total nitrogen (1 mg/L) measured at the site nearest the dam. Both nutrient measures exceeded recommended nutrient criteria set by NEDEQ and EPA Ecoregion (see graph below).

The **US Army Corps of Engineers** (USACE) Water Quality Program collects monthly water samples at Harlan County Lake* from April through September. This report presents data collected between 2010-2019 from lake sites (HC-2,HC-4,HC-5), and the outflow (HC-1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

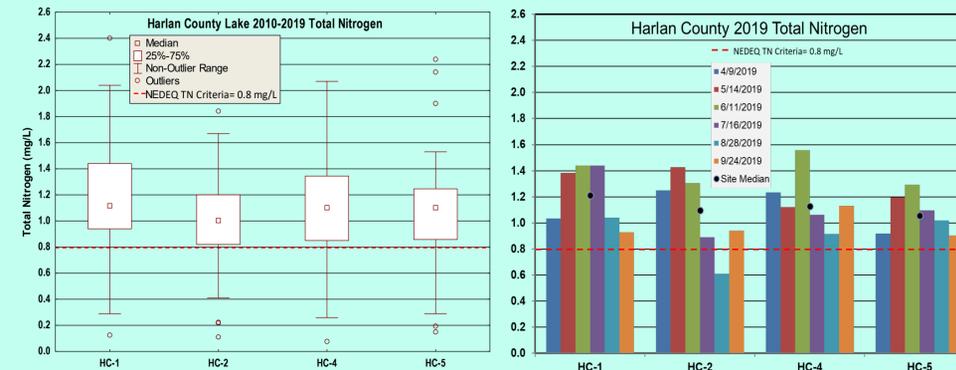
Total Phosphorus

Inflows into Harlan County Lake in 2019 were 2.7 times the 10-year average. Large external phosphorus loads coming into the lake combined with internal loading processes in late summer to create some of the highest phosphorus concentrations on record. Median total phosphorus (TP) concentrations at lake sites in 2019 exceeded 95% of the phosphorus results from all TP data from 2010-2019. August and September samples from all sites were categorized as outliers as values were at 2.5 times greater than the 10-year median at respective sites. TP medians from all sites in 2019 exceeded hypereutrophic thresholds and were at least 6 times higher than NEDEQ criteria (0.062 mg/L). Excessive phosphorus, duration of flood water storage, and increased water clarity during the hottest part of the summer were optimum conditions for blue green algae blooms which dominated most of the lake during summer months. Internal sources of total phosphorus including orthophosphate released by bottom sediments are apparent as TP concentrations increase each month from April-September. Wind action, invertebrates, bottom feeding fish, and bacteria activity also increase the re-suspension of sediment bound phosphorus. Phosphorus stored in algae cells are also part of the total phosphorus measurement.



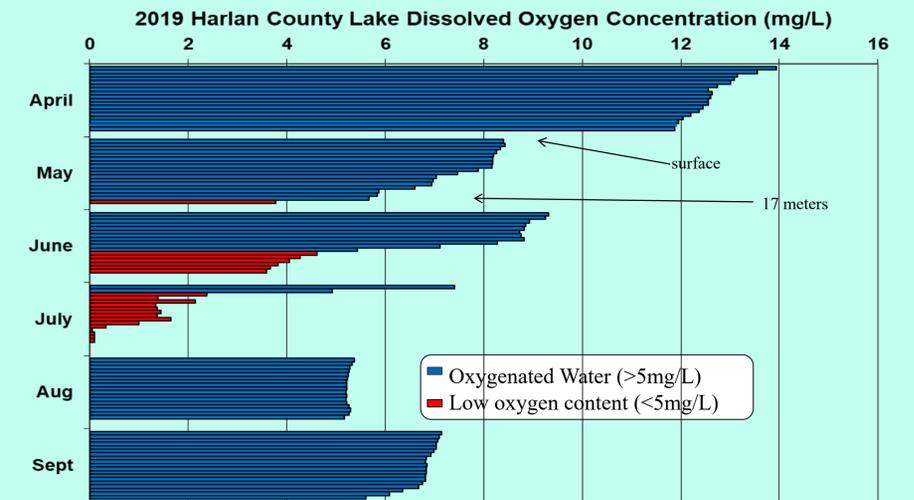
Total Nitrogen

Total nitrogen (TN) calculated from Harlan County Lake typically rank high compared to other District Lakes, but were near average in 2019. Similar to phosphorus, the highest TN concentrations are typically found in upper lake sites from Republican River. Total nitrogen concentrations are higher than NEDEQ TN criteria at all sites from 2010-2019, but median 2019 TN concentrations are very similar to the 10-year TN data.



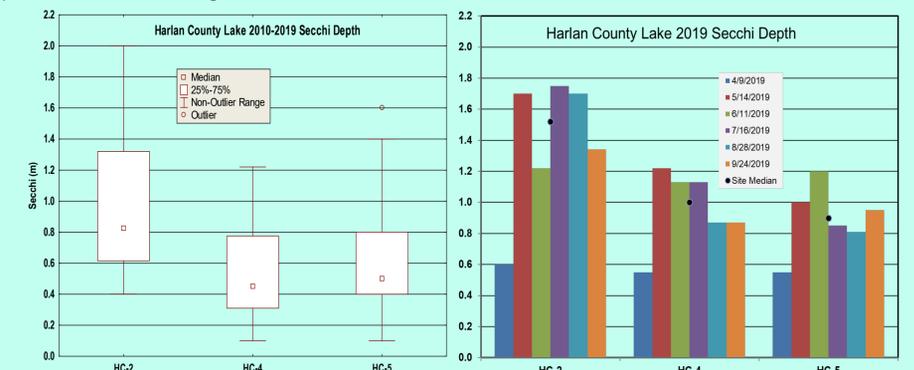
Dissolved Oxygen

Dissolved oxygen is a critical factor in aquatic species location, growth, and survival in lakes. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April through September. Harlan County Lake typically stratifies for a short period of the summer. However, adequate (>5 mg/L) dissolved oxygen is typically available in the surface layers of the lake. In 2019, Harlan County Lake experienced a low oxygen event in July when oxygen concentration was very low except for the top two meters. Signs of fish stress were not observed.



Secchi depth

Secchi depth measurement is most simply defined as water transparency, which relates to light penetration in the water column. Flood reduction efforts in 2019 resulted in longer water residency times through much of the year allowing sediment particles to settle to the bottom and plankton increase. Median secchi depth measurements at all lake sites in 2019 were more than two times the 10-year median and exceeded the 75% quartile indicating exceptional water clarity or transparency compared other years. Increased sunlight penetration and high nutrients contributed to a harmful algae bloom which persisted for a month beginning in late July. Beaches had previously been closed due to safety precautions from high water.



Water Quality Concerns:

- Eutrophication
- Nutrients



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