Clinton Lake Water Quality Summary

2010-2019

The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Clinton Lake* from April through September. These figures present data collected between 2010-2019 from inflow site CL-16, lake sites CL-2, CL-6, CL-12, CL-18, and outflow CL-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.

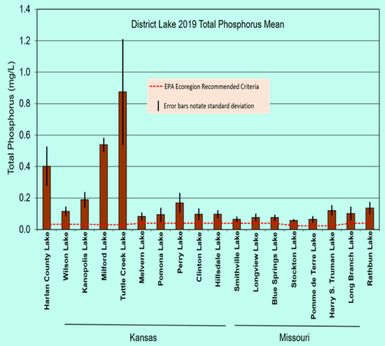
*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

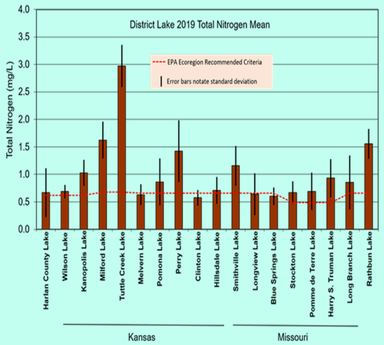
Clinton Lake:

- Located at RM 22.2 of the Wakarusa River
- **Watershed** = 367 sq miles (234,880 Acres)
- **Capacity (2010 sediment survey):**
  - Flood Control: 292,496 Acre Feet (AF) /13,688 surface acres (SA)
  - Multipurpose: 118,699 AF / 7,205 SA / 82 miles of shoreline
  - Multipurpose pool sediment reserve: 8,299 AF
- **Operating project purposes**: flood control, water quality, recreation, fish and wildlife, and water supply.
- **Avg. annual inflow** (2010-2019)= 153,048 AF; **2019 inflow**= 425,818 AF
- **Water Quality (WQ)** at Clinton Lake in 2019 was beneficial to operating purposes listed above and measured parameters did not exceed KS State WQ Standards for designated uses. High surface elevations and physical considerations limited swim beach access in 2019. Water quality generally improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

Nutrient Enrichment

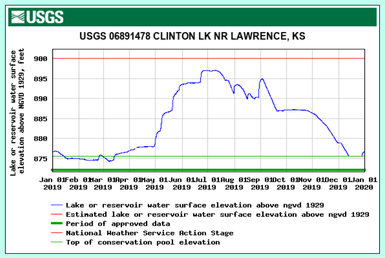
Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life as the basic link to aquatic plant and fish growth rates or productivity. Excess nutrients from urban, agricultural, or natural sources accelerate the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen that affects fish survival, and lead to taste and odor issues in drinking water. Clinton Lake is on the 2020 KS 303(d) list of impaired waters for eutrophication for impacts to aquatic life. The U.S. Environmental Protection Agency (EPA) and the Kansas Department of Health and Environment are working with water quality partners and landowners to focus watershed conservation efforts on priority or target areas in the watershed to reduce nutrient and sediment runoff to meet water quality goals for the upper Wakarusa River and Clinton Lake. At the Clinton Lake Dam (CL-2), 2019 average total nitrogen (TN) and total phosphorus (TP) exceeded EPA Ecoregion recommended criteria. Average TP concentration for 2019 samples collected at the dam (CL-2) were more than twice the 2018 average and exceeded the Upper Wakarusa WRAPS 10-year goal of 0.048 mg/L. Clinton Lake summer TP concentrations classify the lake as eutrophic as described by Carlson's trophic class system (Carlson, 1977).





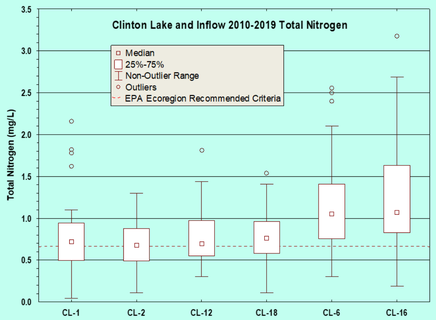
Flood impacts

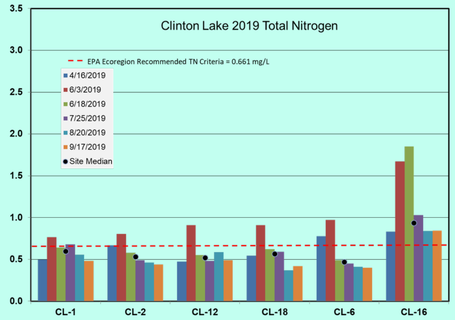
The water year for 2019 was a considered a flood year as lake surface elevation was more than 20' above conservation pool during the growing season. Lake Level Management was drastically altered for downstream flood reduction. Nutrient cycle effects on water quality were observed. Recreational opportunities (i.e. swim beaches, boat ramps and lake access) were reduced by closures. Fishing results reportedly improved due better growth and habitat in flood waters.



Total Nitrogen

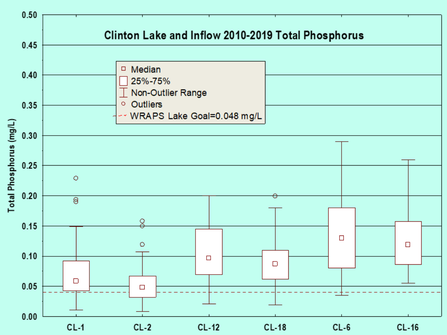
Clinton Lake typically ranks below District lake average for total nitrogen (TN) in most years including 2019. The water year for 2019 was a considered a flood year as lake surface elevation was more than 20' above conservation pool during the growing season. After an initial pulse of nitrogen from runoff, considerable de-nitrification through chemical and organic processes from May through September. Median TN at the dam (CL-2) was below EPA Ecoregion recommended criteria in 2019. TN is a combination of inorganic forms which are available for plant/algae growth and the organic forms of nitrogen not immediately available. Bio-available forms of nitrogen were below laboratory detection limits in 19 of the 24 lake samples in 2019. Nitrogen compounds change forms frequently as atmospheric and terrestrial sources move into and through the aquatic environment.

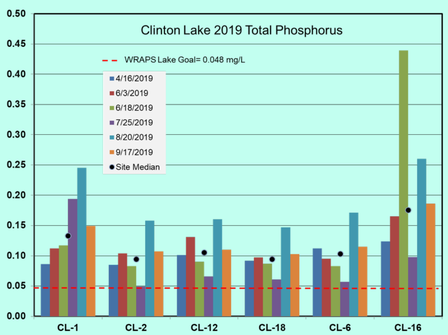


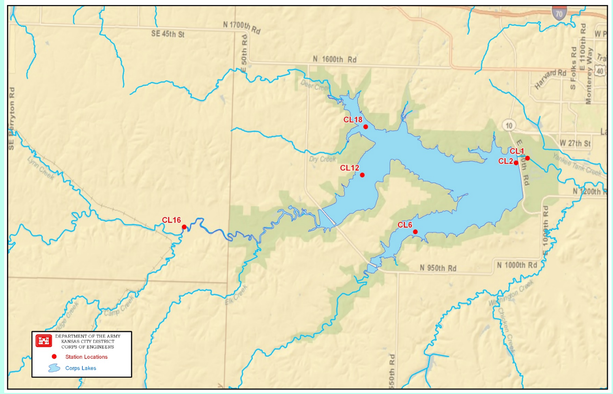


Total Phosphorus

Clinton Lake 2019 total phosphorus (TP) data generally higher than TP data for 10-year period 2010-2019. TP from large inflows measured at CL-16 exceeded the 75% quartile of 10-year TP data and charged the system for 2019. Median TP concentrations from 2019 Clinton Lake samples exceeded Clinton Lake WRAPS 10-year average goals at all sites. Median TP at all Clinton Lake sites are in the range of high biological productivity and are categorized as eutrophic (Carlson, 1977). Significant runoff events and increased inflows, up to 12000 cfs, in August and September can be linked to spikes in TP at the end of the sample season. Similar to most impoundments, higher TP concentrations and a wider range of data is usually found at the upper lake sites (CL-6 and CL-12) due to inflows and internal loading from nutrient rich bottom sediments. TP tends to decrease from biological uptake and settling of sediment-bound phosphorus as the water moves from the upper lake (CL-6) to the dam (CL-2). Internal phosphorus loading was not as apparent in 2019 as inflow events dominated the phosphorus cycle.

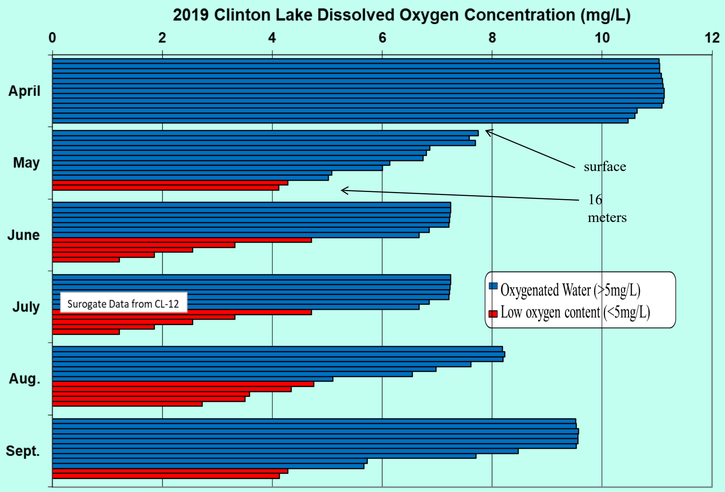






Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Many lakes undergo a process called thermal stratification and develop layers based on temperature and oxygen. This process begins in late spring, remains throughout the summer, and mixes (de-stratifies or 'turns over') in the fall. 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 May-September at the dam (CL-2). Clinton Lake typically stratifies during summer months and lack of adequate (<5 mg/L) dissolved oxygen can be a concern. Clinton Lake profile data illustrates stratification in 2019 peaked in August. The top 7 meters of depth had optimal dissolved oxygen conditions.



Water Quality Concerns:

- Sediment inputs
- Eutrophication
- Dissolved Oxygen

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