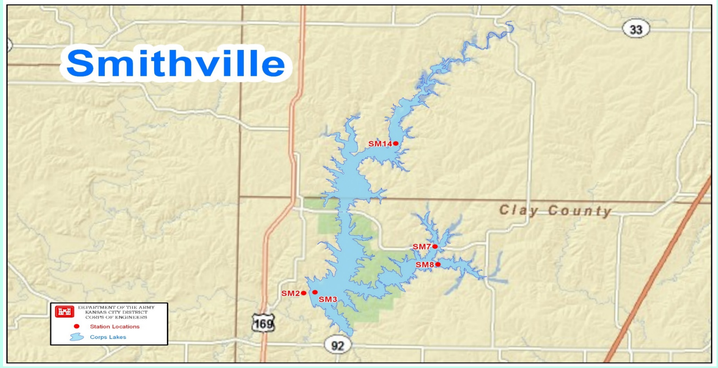
Smithville Lake Water Quality Summary

2009-2018

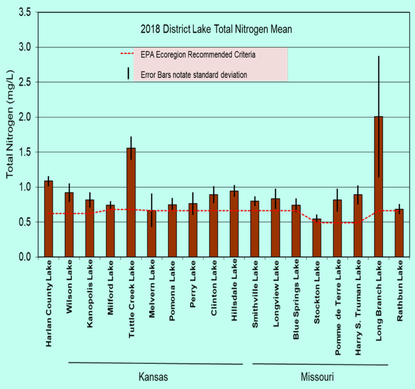


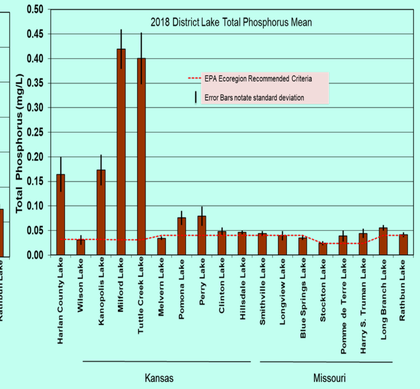
Smithville Lake

- Built on Little Platte River reaching full pool in 1982.
- **Watershed** = 213 square miles / 136,320 Surface Acres (SA)
- **Capacity:** Flood Control: 101,777 Acre-feet (AF) / 9,990 SA
  - Multipurpose: 141,666 AF / 7,115 SA / 175 miles of shoreline
  - Avg. annual inflow (2009-2018) = 128,017 AF; 2018 inflow = 53,295 AF
  - **Operating project purposes**: flood control, water quality, recreation, fish and wildlife, and water supply.
- **Water Quality** was beneficial to operating purposes listed above and measured parameters did not exceed Missouri State standards for designated uses. 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 and are the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increase the natural aging process in lakes. This rapid aging process, called eutrophication, is responsible for changes in plant and aquatic life in lakes and water bodies including algal blooms, low dissolved oxygen, and taste and odor issues in drinking water. Missouri Department of Natural Resources (MDNR) led a multi-agency work group to establish Missouri Numeric Nutrient Criteria for Lakes to minimize and eliminate adverse effects of nutrient enrichment to aquatic life in Missouri lakes. Geometric mean of summer total phosphorus (TP), total nitrogen (TN) and chlorophyll-*a* were less than the nutrient screening threshold (see respective sections. Smithville Lake TP concentration exceeded EPA Ecoregion recommended criteria and most of the lake can be classified at the low end of the eutrophic range (i.e. 0.24-0.96 mg/L) as described by Carlson's trophic class system (Carlson, 1977). The first harmful algae bloom (HAB) was documented at Smithville in 2015 due to excess nutrients from large inflows. No harmful algae blooms or beach closures were documented in 2018



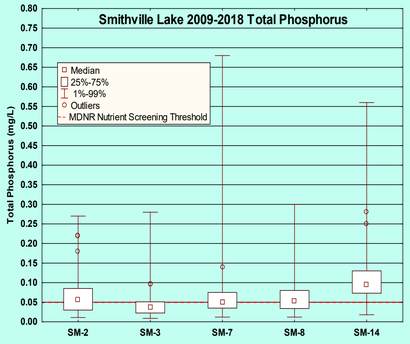


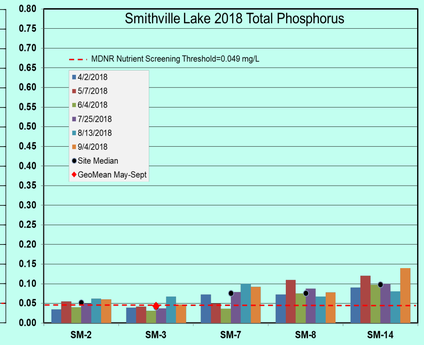
The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Smithville Lake* from April through September. These figures present data collected between 2009-2018 from four lake sites (SM-3, SM-7, SM-8, SM-14), and the outflow (SM-2) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe 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

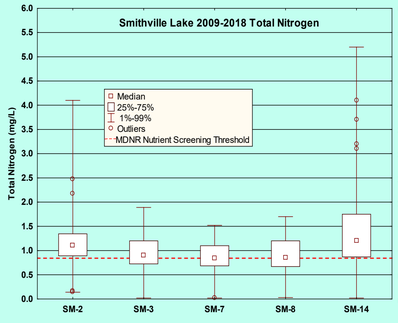
Total phosphorus (TP) median concentrations from 2018 Smithville Lake samples were within the central 50% quartile of 10-year TP data (2009-2018) at all sites except SM-7. The geometric mean of TP at the dam (SM-3) was slightly less than the MDNR Nutrient Screening Threshold. Similar to most impoundments, higher TP concentrations and a wider range of data is usually found in the upper lake sites and inflows due to mobilized nutrients bound to silt particles in moving water in inflows. Phosphorus concentration declines from biological uptake and settling as the water moves through the lake from inflows toward the dam. Soluble phosphorus available for plant growth is found in very low concentrations during summer months due to uptake by algae in Smithville Lake.

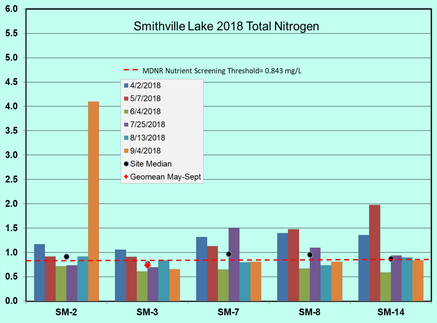




Total Nitrogen

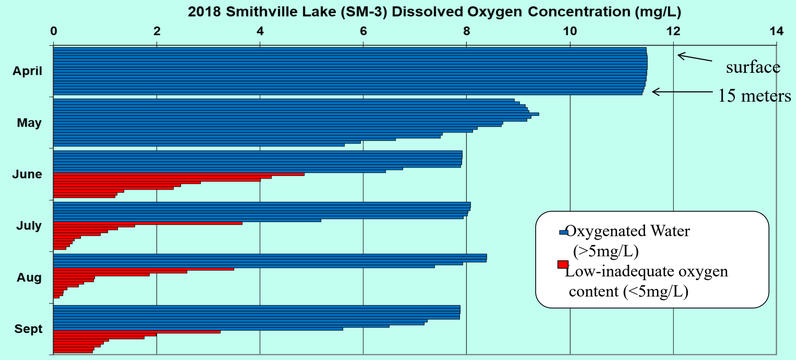
In 2018, median total nitrogen (TN) concentrations were within the central 50% quartile of 10-year TN data. The geometric mean of summer TN at the dam (SM-3) was slightly less than the MDNR Nutrient Screening Threshold. Much of the nitrate form of nitrogen available for plant growth is used up by the healthy algae community through the summer months and decreases as water moves toward the dam through Smithville Lake. Total nitrogen concentrations are highly variable between sites and years and are most related to inflows, conversion of nitrates and watershed factors (i.e. soils and farming practices). Peak nitrogen concentrations typically occur near moving water at inflow, upper lake and outflow sites.





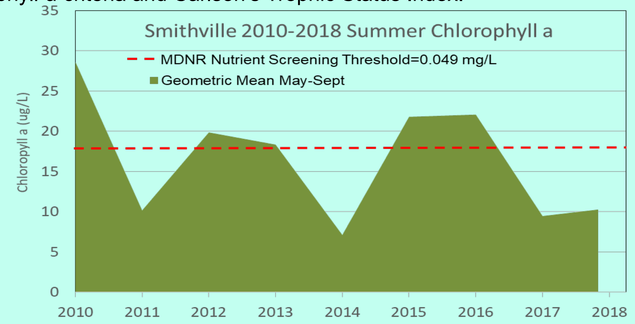
Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Smithville undergoes a process called stratification and developing layers based on temperature, oxygen and chemistry. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (each row in each month represents one meter of depth) from April through September. Smithville Lake typically stratifies during summer months and low dissolved oxygen (i.e. 5 mg/L or less as shown in red) can stress aquatic life including fish. During the stratified period of 2018, Smithville Lake had sufficient dissolved oxygen from the surface layer to 5 meters during all stratified months.



Algae

Algae and green plants are the base of the food chain in aquatic food webs and convert nutrients and CO_2 through photosynthesis into biomass for all aquatic life. Chlorophyll is a measure of the active green pigment present in beneficial algae and harmful blue-green algae (cyanobacteria) active in this process. Chlorophyll is a critical measurement as it relates the plant nutrients (phosphorus and nitrogen) to biological productivity and trophic status related to algae (good and bad), aquatic invertebrate production, and fish growth. Blue-green algae is present, but algae populations in Smithville Lake are typically dominated by beneficial species. MDNR Numeric Nutrient Criteria uses chlorophyll-*a* as the keystone metric to describe lake impairment to aquatic life. Excessive algae, as measured by chlorophyll concentration, indicates that high nutrients are having a direct impact on aquatic life. The graph below depicts that summer chlorophyll exceeds the nutrient screening threshold 55% of the last 9 summers. All lake sites are classified as eutrophic using chlorophyll-*a* criteria and Carlson's Trophic Status Index.



Water Quality Concerns:

- Eutrophication-Low Dissolved Oxygen
- Nutrients
- Sediment inputs
- Algae blooms

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